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The Baltimore Belt Line Ry. tunnel was officially declared completed, on Feb. 1, so far as the work of the contracting firm of Ryan & McDonald was concerned. This tunnel was commenced in September, 1890. This 7 miles of railway, which constitutes the Belt Line, extends from Camden Station to Bay View, and was built by the Baltimore & Ohio R. R. Co. under M. A. T. Manning, as Chief Engineer and Wm. Howat as Engineer of Construction, to avoid the old ferry system. It includes a main tunnel 8,400 ft. long, besides a number of shorter tunnels. The average section of tunnel is 27 ft. across the springing line and 21 ft. high, inside measurement, and the tunnel is lined with from 24 to 30 ins. of brickwork. The total cost of the line up to date has been over $7,000,000; but considerable more money will have to be expended for station grounds and buildings, power-houses, etc. This was a soft-ground tunnel driven under one of the principal streets of the city, with sewers, water and gas mains, and street-car lines overhead. All of these appliances were maintained in operation during construction. The only accident of any moment was the damage to the City College, following an inrush of water from an unknown source, and though from 500 to 2,000 men were employed on this dangerous work, but three men lost their lives from accident. Mr. E. J. Farrell was in responsible charge of the whole work from start to finish, but Mr. J. B. McDonald, of the firm above-named, was also constantly on the ground and had very much to do with the successful conduct of the work. It is expected that the line will be in full operation in about two months more. The first train through was a fast freight, which also carried in a car attached a number of the officers of the B. & O. R. R. Co., engineers and employees of the contractors. This important work has been fully described in Engineering News of Jan. 28, 1890, Dec. 12 and 19, 1891, Jan. 16, 1892, and May, 18, 1893.

At a meeting of the New York Rapid Transit Commission on Feb. 5 the Ryan & McDonald Construction Co. and the Drake & Stratton Co. offered to build the entire West Side line to the Harlem River and the East Side line to 42d St., "for a sum less than $50,000,000." It transpired, however, that they were not ready to take the contract to operate as well as build the road, as the law requires. The recommendation of the Board of Experts that additional facilities be granted to the Manhattan Co. was taken up and a resolution was adopted that as the granting of such facilities would lessen the value of the Rapid Transit franchise, they should not be granted. The Board of Experts' recommendation that New Elm St. be substituted for Broadway, between City Hall and 14th St., as the route of the line was discarded on the advice of the Commission's counsel that legal complication were likely to delay the opening of New Elm St. for two years or more. A resolution was adopted instructing the Commission's counsel to draft an instrument for formal adoption at the next meeting calling for immediate construction on the west side as far as 185th St. and on the East side as far as 42d St., with extension to the city limits on each side, and a branch through the blocks above Central Park to be built within a time to be hereafter determined.

A novel departure in street-car lighting has been made by the Columbus Central Ry. Co., of Columbus, O. The company's lines are operated by electricity, but it has recently arranged to discard electric lamps for lighting its cars and has equipped 20 of its cars with Pintsch gas lamps, furnished by the Safety Car Heating & Lighting Co., of New York city. Each car has two 4-flame lamps. Equipment for 40 more cars has been ordered. The company has set up a small gas-making and compressing plant for its own use, and is said to be greatly pleased with its new lights.

From its 403 miles of passenger railway tracks the city of Philadelphia collected for the year 1893, $61,358 in car licenses, and $77,297.74 in taxes on dividends. This is a total of $139,298, or an average of $345.40 per year per mile of passenger track.

Side-door electric cars are to be run by the Detroit Ry. Co. The cars are 24 ft. long over the body, with vestibuled front platform and open rear platform, and a sliding door in the middle of one side, along which side there is a passageway, the transverse seats being shorter than the width of the car. Only one side door is required, as the car will turn on loops at the ends of the line.

The most serious railway accident of the week was a rear collision on the Baltimore & Ohio R. R. at Woodell, Pa., Feb. 2. An eastbound express train ran through a misplaced switch and collided with a freight train standing on the sidetrack. One man was killed and two were injured.——A mixed train on the Indiana & Illinois Southern R. R. was derailed Feb. 3 near Oblong, Ill., and four freight cars and the passenger car went down the bank, six persons being injured, but none seriously.——The engine and tender of a train on the Intercolonial Ry. were derailed at Jacquet River, N. B., Jan. 30, by ice which had formed on the rail at a leaky water tank, and the engine went down the bank.

Several boilers of a battery of twelve in the Grand Ave. power-house of the Denver Tramway Co., Denver, Colo., exploded Jan. 30, wrecking the building, while three men were killed and three injured. The boilers were of the tubular type, rated at 125 HP. each.——The boiler for the machinery at Carpenter & Sons' icehouses at Mashapaug Pond, near Providence, R. I., exploded Feb. 4, and four men were killed.——Two boilers at Gray Bros.' planing mill, Muskegon, Mich., exploded Feb. 3, and one man was killed.

A runaway coal car on the Castle Shannon inclined plane, at Pittsburg, Pa., smashed a shanty at the bottom of the grade, seriously injuring two men. The car was at the head of a descending train and its coupling gave way.

The sinking of the "Elbe," reported last week, occurred in the early morning of Jan. 30, the morning being very dark and cold. The steamer "Crathie," bound from a Dutch port to Aberdeen, struck the "Elbe" a square blow, cutting such a gash that the latter vessel sank in 20 minutes. Only 22 persons were saved and 335 lives were lost. We have commented upon this accident in our editorial columns.

An explosion of natural gas occurred Feb. 3 at 85 Kinzie St., Chicago, wrecking the one-story building and tearing up the sidewalk under which the pipes were laid.

An electric car at Milwaukee, Wis., ran into the open draw of the Kinnickinic Ave. bridge Feb. 4. The car was running at fair speed and the brake failed when the motorman applied it. The car broke through the ice, but was prevented from going to the bottom of the river. Three persons were drowned and six were rescued.

The steamer "Cienfuegos" of the Ward Line, went ashore near Harbor Island, Nassau, West Indies, Feb. 5, but the passengers, crew and mail were landed in safety. It is thought the vessel will be lost. It is an iron steamer of 2,332 tons, built at the Roach yards in Chester, Pa., in 1883, and is 292 ft. long, 39.8 beam and 22.3 ft. depth of hold.

A car fender ordinance was passed some time ago at Baltimore, requiring street cars to be equipped with fenders by Jan. 15, but it was not generally obeyed, so the city is now suing some of the officers of the companies for violating the ordinance.

Car fenders are to be adopted at Washington, D. C., according to an act of Congress, and the District Commissioners have made a regulation that by April 1 all grip and motor cars must be equipped with the Blakistone fender (Eng. News, Jan. 3) and the Brightwood, Blakistone, Eldridge-Smith or other approved wheel guard fender. All motor cars are required to have a clearance of 15 ins. above the rails.

The abolition of grade crossings at Buffalo, N. Y., seems in a fair way of being carried out. The schedule of work on the New York Central R. R. was given in our issue of Jan. 31, and the Lake Shore & Michigan Southern Ry.; New York, Lake Erie & Western R. R.; Buffalo Creek R. R.; Western New York & Pennsylvania R. R., and Buffalo, Rochester & Pittsburg R. R. are now said to have expressed their readiness to enter into contracts to do their share of the work.

A grade-crossing bill has been sent to the New York Legislature by the Railway Commissioners of the state. The bill is designed to prevent the making of future grade crossings and to gradually eliminate those in existence. Special attention is paid to the prohibition of the crossing of steam roads by electric roads. An abstract of the proposed law was given in our issue of Jan. 17.

A grade crossing bill, prepared by the City Council of Newark, N. J., provides that upon the petition of the board of works and the mayor, or upon the petition of the directors of the railway company, the Justice of the Supreme Court of the county, after a hearing, may appoint a commission of three disinterested persons to consider the proposed abolition of grade-crossings. If it decides, after hearing, that the alterations are necessary, it shall prescribe the manner and limits within which the alteration shall be made and shall decide whether the city or the railway, or both, shall do the work. The railway company or companies are to pay 65% of the total cost, including salaries and all damages; city and state to pay 35% and no more than 10% to be paid by the city. When the street or highway crosses the railway by an over bridge, the bridge shall be maintained by the railway and the surface of the bridge and its approaches by the city. When the public way passes under the railway, the bridge shall be maintained by the railway and its approaches by the city.

A pneumatic tube, to connect the New York and Brooklyn post offices, and crossing the Brooklyn Bridge, is proposed by Postmasters Sullivan, of Brooklyn, and Dayton, of New York. The distance is a little more than 1½ miles. A tube 3 ft. in diameter is proposed, large enough to take an ordinary mail-sack. It now takes 27 minutes to transmit the mails between these two points, and they could be sent through the tube in about five minutes. The matter has been referred to Chief Engineer Martin, of the Bridge Company, for examination and report.

Rails 60 ft. long are now in use on several roads and it is reported that they are to be tried on the Hudson River Division of the New York Central R. R.

An asphaltic grout, made from the Utah asphalt deposits, has been used as a filler for a part of the brick paving at Marion, O. The contracts called for a Murphy patent grout on one street, and a Portland cement grout on the other. The city council became dissatisfied with the latter and changed to the asphalt at the same price as tar filler No. 6. It was late in the season when the change was made, so that the experience is limited, and nothing is known as yet of the effect of the summer heat, but the material seems to possess toughness and adhesiveness, as even in the recent cold weather it was not brittle like the tar filler, but pliable and tough.

The electric railway system of the Hestonville, Mantua & Fairmount Passenger Ry. Co., in Philadelphia, is now nearly completed and the principal lines are in operation. The entire system will aggregate about 20 miles. The track is 5 ft. 2½ ins. gage, laid with 90-lb. girder rails and 13 yellow pine ties 7 ft. × 5 ins. × 9 ins. to a rail length. The Johnson rail bond is used (Eng. News, June 14, 1894), and the tracks are cross-bonded and connected to a ground return wire at manholes 300 ft. apart. Wrought iron side poles are used. The power house is located at Callowhill St. and the Schuylkill River, and contains three Greene tandem-compound engines of a capacity of 750 HP. at 100 revolutions per minute, connected direct to multipolar generators of 400 KW. The boiler room contains eight Babcock & Wilcox boilers of 250 HP. each. Coal is unloaded from barges by a link belt elevator and conveyor. Each car is equipped with two 25-HP. motors, eleven incandescent lamps and electric push buttons between the windows. The work has been done under the supervision of Mr. A. Langstaff Johnston, M. Am. Soc. C. E., Consulting Engineer.

Solid emery whetstones, designed for sharpening all sorts of tools and cutlery, are being put on the market by the Tanite Co., of Stroudsburg, Pa. The revolution in the art of sharpening tools which was wrought by the introduction of emery wheels in place of grindstones, is now familiar; but it is not generally realized that an equal gain remains to be made by the substitution of sharp and rapid-cutting emery stones in place of the slow-cutting whet stones, oil stones, hone stones, etc., still in common use for sharp-curving tools by hand. The fact that it is expensive hand labor which is economized by the introduction of emery stones, makes the saving which may be made enormous in total amount even though it may be small in each individual case.

A BRIDGE WORKS' RULES FOR DRAFTING ROOM WORK.*

By Chas. H. Wright.

When instructions are given to the drafting department of a bridge works to proceed with a contract, the following information should be furnished:

1. A masonry plan (if the masonry is built) giving the clear span, width of bridge seats, and distance from base of rail to masonry, angle of skew, and grade of track. If the masonry has not been built (the length of span having been determined), plans giving all measurements affecting the ironwork should be furnished by the bridge company for the guidance of those making the masonry plans.

2. A complete stress sheet giving all main sections and any special features there may be in the work. The stress sheet is usually accompanied by general drawings or standard detail cards giving the style of details used in the estimate.

3. The estimate of weight, showing the amounts allowed for details.

4. A copy of the specifications.

5. Any special instructions that may have been received from the railway company, copies of letters relating to the work, etc.

6. A sheet of general data similar to that shown in Fig. 1.

The more full and complete the above information is given, the more time and expense will be saved in the drawing room. In the larger bridge offices the drawing room force is divided into equal squads of five or six men, in charge of an assistant engineer; and the assistant engineers are under the directions of the "Engineer in Charge" of the department. This arrangement affords an opportunity to compare the work of the different squads as to accuracy and amount performed, and stimulates a healthy rivalry among the men. A record should be kept of all expenses in the shop or in erection caused by errors on the drawings.

Rules for making drawings are mainly valuable in giving greater uniformity. Drawings plainly made and uniform in arrangement are essential to amicable relations between the drawing room and the shops. A draftsman very soon establishes a reputation (good or bad) in the templet and rivet shop, and upon this reputation depends his peace of mind, to a great extent. The following set of rules and instructions are in use in one of the largest bridge offices, and are found to be very satisfactory in their results.

Size of Sheets.—Drawings will generally be made made on sheets $8\frac{1}{2} \times 14$ ins.** One of these two sizes is drawings, such as details of castings, etc., may be made on sheets $8\frac{1}{2} \times 14$ ins.** One of these two sizes is to be used in all cases.

Borders.—The border will consist of a single heavy line drawn around the sheet at the distances given above. Trim the sheets so as to leave about ¼ in. outside the border line.

Titles.—The titles will always be placed in the lower right-hand corner, as near the border line as possible (for convenience in referring to the drawings after they have been filed). The arrangement and lettering to be similar to that shown in the standard title. All lettering must be done freehand, except the parts which are made by stamps. The titles must contain as full a description of the bridge as possible, in about the following order: The contract number, number of sheet, name of the part of the bridge shown on the sheet, number of tracks in the bridge, deck, or through span, length, depth and width, number of panels, location of the bridge and name of road or purchaser, date of drawing, initial of the draftsman and scale. The size for countersunk and flattened rivets to be stamped near the title.

Scales.—In truss work use 1½ or 1¼-in. scales where possible. In girder work 1-in. scale is generally large enough; the larger the scale, the plainer the drawing will usually be.

* From "A Manual for Bridge Draftsmen," now in preparation. Copyright, 1895, by Chas. B. Wing, Professor of Structural Engineering, Leland Stanford University, and Chas. H. Wright, Edge Moor Bridge Works.

** The size $8\frac{1}{2} \times 14$ ins. was taken as it was the size used for estimate blanks, detail sketch paper, etc. Where there are large numbers of drawings, estimate sheets and blanks of various kinds, a few standard sizes are a very great convenience, as any one who has been accustomed to a multitude of odd sizes can testify.

Details of castings or parts requiring scaling or a large amount of figuring should be on 3-in. scale or full size, as the case may require.

Plate Girders.

At the upper left-hand corner of the sheet put a diagram, giving the length and depth out to out of angles, and width c. to c. of girders.

Show cover plates by single heavy lines, and give their length; show number of rib angles and mark web and flange splices.

Below this make a line diagram giving number and size of lateral brace angles, or rods and struts.

A.B. Bridge Works.

A.B. B. W. Contract No. _____

Purchaser's Contract No. _____

Name of Structure _____

For _____

Date of Order	Date of Contract	Total Contract Price	Estimated Weight	Actual Weight	To Be Shipped
					Final Shipment
No. Duplicate Sets	Through or Deck	No Panels	Length C. to C.	Width C. to C.	To Be Completed
Pin Connected, Riveted Truss or Late Changes	No. of Tracks	Sidewalks No. and Width	Length E. to E. Riveted Girders	Height C. to C.	Date of Completion
Contract Lump Sum or Pound Price	Has Stress Sheet Been Furnished or Approved.	Is Masonry New or Old	Is Special Freight Rate Required	Freight to be Prepaid to	Freight Rate

Ordered by _____ Address _____

Inspected by _____ Address _____

To be Consigned to _____ Address _____

To be Erected by _____ Address _____

According to what Specification _____

Floor Beams, Relative Position to Chords _____

Square or Sketch of Skew _____

Who Furnishes Working Drawings _____

Who Furnishes Masonry Drawings _____

Shop Painting, Number Coats, Kind and Color _____

What Full-Sized Tests Required _____

Are Pilot Nuts to be Sent with Structure _____

Are Floor Bolts to be Sent with Structure _____

Wood Floor to be Furnished by _____

Wood Floor to be Laid by _____

Description of Wood Floor (Cross Ties, Wheel Guards, Joists, Plank, Hub Guards, etc.) _____

Structure to be Shipped to _____

What Transportation will be Furnished for Men and Materials _____

Name of Stream _____

Character of Bottom of Stream _____

Depth of Stream Ordinary Stage, ____ ft. flood or high tide, ____ ft.

Bridge Floor or Base of Rail to Bed of Stream _____

Will Piling be Required for False Work _____

Who Furnishes Material and Builds False Work _____

Present Structure, Kind, Removed by Whom, How Disposed of _____

Is Travel to be Continued during Erection _____

Which End of Bridge Best to Erect From _____

Field Painting, Number Coats, Kind and Color _____

BLANK TO BE FILLED BY CONTRACTING DEPARTMENT FOR USE OF DRAFTING DEPARTMENT.

If the girder is symmetrical about the center, only half the length need be shown; if it is not symmetrical, draw the full length, taking two or three sheets if necessary.

Place the elevation view near the center of the sheet, and draw top bracing above, and a section showing bottom flanges and bracing, if any, below.

The sheets are to be arranged to paste together for shop use. On a separate sheet, if there is not room on the sheets with the girder, draw the cross frames, bedplates and rollers, if used.

The general arrangement of spacing, etc., should be such as to avoid crowding lines or figures.

Care must be taken to have rivets in flanges interspace, or stagger, and to see that the distance between the rivets is within the limits allowed by the specifications.

Connection plates for laterals or struts should be drawn out on a larger scale where there is not room to give all rivet spacing clearly. Locate the ends of all cover plates from the nearest stiffening angles, and all splices in flange angles or cover plates in the same way.

Where angles have legs of unequal width, mark plainly which way they are to be placed.

Give on one of the sheets a complete bill of material, billing lateral bracing and struts separately.

Where several sheets are to be pasted together, the full title should be given on the last sheet, and on the others merely the sheet and contract numbers in small size figures.

The method of numbering sheets and the assembling marks used are shown later under pin-connected spans.

Lattice Girders.

Lattice girders are to be drawn in precisely the same manner as plate girders, except that a larger scale should be used, 1¼ ins. or 1½ ins. to the foot, for convenience in figuring the web members and their connections to the chords.

Considerable care is needed to give the dimensions required and have the figures and arrow points showing where they belong all perfectly clear and plain.

Pin-Connected Spans.

Where the span is long, and the depth is too great to permit the members to be shown in position, on a scale large enough for detailing, , a general drawing should first be made a ½-in., ⅝-in. or ¾-in. scale. Show on this drawing all pin packings, beam and stringer connections, lateral and strut hitches, etc. Usually by filling in the shipping marks of the various pieces, this general drawing can be used for the erection diagram.

Having the general drawing complete, the detail drawings can now be made from it. Combine on the same sheets parts of the same character, as end posts and top chords, on one sheet, vertical posts on a second, beams or stringers on a third, and so on, making, of course, no attempt to show the several parts in their relative positions.

If the location of tie-plates, length of cuts, etc., cannot be scaled on the general drawing with sufficient accuracy, the joints must be drawn out on waste sheets to a large scale, and all cuts, countersunk rivets and clearances carefully determined.

On each sheet there should be a line diagram of the bridge, and the members shown on that sheet should have the shipping marks given on the diagram, as a convenient reference for shop men.

In moderate spans, where the depth of truss is not too great, make a skeleton of the truss on ½-in., ⅝-in. or ¾-in. scale, taking as many sheets as are necessary to show the half length of the truss. (In skew spans it may be necessary to show the full length.)

Upon the skeleton, draw the details to a 1¼-in. or 1½-in. scale. Show the posts, diagonals, etc., in position. In this view the draftsman is supposed to stand in the center of the bridge looking up or down stream. This enables him to show the connections for floor beams, struts, etc., without dotting them in behind other parts.

The advantages of this method are that no general drawings are required, the detail drawings answering the same purpose. If desired, these drawings may be finished so far as to give sizes of all pieces and general details, and be sent for approval to the railroad company before bills of material, the rivet spacing in small pieces, etc., are put on the sheets. This amounts practically to making the general drawings

on such a scale and in such a manner that they may be filled in later and used for detail drawings.

By showing the several parts in position there is much less liability of the average draftsman overlooking points of interference, such as placing tie-plates too near panel joints, not making cuts in posts or chords long enough to clear diagonals, etc.

When the drawings are made in this manner, the erection diagram may be made by single heavy lines, each eyebar in packings being shown by a heavy line.

The disadvantage of the system is that care is required in showing the several members at the panel points, without confusing some of them or covering up rivets, etc. By showing the posts and eyebars where they come inside the chord by fine lines, and using care, there is no great difficulty in doing the work properly. A slovenly draftsman can make a botch of almost anything he attempts.

Proceed with the work of detailing as follows: In the upper left-hand corner of the sheet place a small line diagram, giving the shipping marks, splices, etc., for convenient reference.

Arrange the skeleton of the truss upon which the details are to be filled in, so that there will be room at top and bottom of the sheet for the various views required.

On the side elevation of the truss show the webs, flange angles, edges of cover and tie-plates, lattice, etc. Give size of bearing plates, ties, etc., or dimension lines parallel to the piece.

Give all web rivet spacing, but not the spacing in cover plate or on under side, in this view. Mark the diameter of pins with figures enclosed in a circle, giving the size of pin and not the size of the hole.

Above the side elevation of chords or end posts show a top view and longitudinal section combined. Give the rivet spacing for top and bottom, separately. Show the lattice on bottom dotted in under the cover.

At the center of the panel show a cross section of the chord with the post, eyebars, etc., in position. In this view give all the pitches on angles and plates, and show strut and lateral connection to chord or pin.

Near each pin give a bill as follows:

A³.
4-in. steel pin, 20-in. grip.
2 Lomas nuts, 2½ in. tap.
2 collars, 2 ins. long, etc.

Posts.—Show the vertical posts in position in the chords by fine lines. Break the post off just below the chord, extending it only far enough to show the cuts in the flanges, countersunk rivets and such points of clearance, etc., as there may be. Then, either below the break or to one side, as may be most convenient, show the post complete. When the beams rivet to the posts and the two sides of the post are different, show both sides. Near the center of the post show a cross-section, giving the pitches of all rivet lines. Show the packing of the eyebars in plan. Give continuous lines of rivet spacing for flange angles and webs. Mark all small pieces on dimension lines. Close attention to uniformity and arrangement requires very little extra time and improves the appearance of the drawings very much.

Eyebars, Counters, Etc.—Give the sizes of all diagonals and chord bars, the lengths center to center of pins, diameter of the heads and whether the bars are steel or iron. On counters give the diameters of the upsets, lengths of loops, etc.

Beams and Stringers.—Give extreme length and depth of beams and stringers out to out of flange angles. Give the distance center to center of trusses for beams, and center to center of beams for stringers. Make the length of stringers 1-16 in. less than the clear space between the beam webs. Make the depth of beams and stringers from ⅛ to ¼ in. more than the width of the web plates. When stringers rivet to the beam webs, the depth of the stringer should be ¾ in. less than the clean depth of the beam between the flange angles, to allow for the amount the legs of the flange angles will overrun in width. Make such top and bottom views and sections as may be necessary to show clearly all lateral hitches, etc. Make in some convenient space on the sheet a small line diagram showing the size of the laterals and the size of the lateral pins for each beam.

Struts.—Give the length between the end field-holes for struts having riveted connections and length between pin-holes and extreme length for struts with pin connections. Give the bevel for all bent plates, mark the sizes of all small pieces on dimension lines, as for chords, etc.; locate carefully all holes for knee braces on a bottom plan of the strut, locating the rivets so that they may be easily driven in the field.

Portal.—Particular care is necessary in making the portal drawings to see that the rivets in the connections at the hip are so arranged that they can be driven in the field. When curved brackets are used, it is often necessary to use bolts in the holes near the ends, as these holes are covered by the curved angles.

Bills.—Near each main member give a complete bill of material, allowing the amounts over finished lengths as given in the rules for ordering material. Give each piece its assembling mark. Marking up the pieces must be carefully done, as the work goes all through the shops by these marks. Pieces having the slightest difference must be marked differently.

When two pieces which go to make up a member are exactly alike, they should always have the same mark, even though they will be made in pairs or are right and left. But if two pieces are different in length, width, thickness or shape, even though they occupy similar positions, give them different assembling marks. If they are alike in size and weight and only vary in punching, give one the same mark as the other with a suffix. For example, the stringer flange angles on a certain stringer are exactly alike, and so they are given the same assembling mark. On a certain floor beam, they are the same size and length, but have extra holes in the bottom flange for the lateral hitch plates, so they are given a "prime." Again, on a stringer the four end rib angles are all the same section, but two of them have open holes in the outstanding leg to take the brace frame, and they also have fillers under them, while the second pair are crimped. There being so much difference, they are given a separate mark; if they had been different only on the open holes, they would have been given only a prime. In giving assembling marks begin with the letter A and go through the alphabet, omitting the letters I, J, O, Q, X, which are liable to be confounded with other letters, and then take the second AA, AB, AC, etc., then BA, BC, BD, and so on as far as needed.

Use as simple letters and as few as possible in marking. Use capital letters in marking members and small letters in marking pieces (as for assembling marks).

In giving figures take care to have them large enough to be plain and not crowd them. Take special pains in marking the size of pins and similar pieces where the space is limited.

It is not necessary for the draftsman to mark the right and left of small pieces, but it is very important to mark the right and left of main members. If members are not interchangeable they are either right and left or entirely different, and should have another mark.

The right and left may be determined by considering an imaginary line and placing one member on each side. If the notching, or hitches, or whatever prevents the member from being interchangeable are in precisely the same positions relative to the imaginary line, then they are right and left. If not, they should be marked differently.

Size of Rivets.—Under each bill of material give the size of rivets to be used and the size of open holes.

Shipping Marks.—Near each member give the number to be made and the shipping mark of the piece. Where members occupy similar positions in the structure, but are of different make-up, have different sizes of pins, etc., they are usually given the same mark with a suffix, as U^1 and $U^{1\,a}$, L^2 and $L^{2\,a}$, etc. Below is a general shipping list which is useful as a guide and as a check:

General Shipping Bill.

Bridges.

End posts,	Stringer beds,
Top chords,	Stringer frames,
Int. posts,	Pins and rollers,
Bottom chords,	Lateral and sway bolts,
Diagonals,	Anchor bolts,
Suspenders,	Stringer shoes,
Counters,	Stringer bracing,
Laterals,	Sidewalk brackets,
Sway rods,	Castings,
Floor beams,	Hook track bolts,
Stringers,	Floor bolts and washers,
Bottom struts,	Field rivets and bolts,
End post "	Construction bolts,
Portal "	" washers,
Sway "	Paint,
Top struts & knee braces,	Nails and spikes,
Portal brackets,	Scaffold bolts,
Shoes,	Pin pilot,
Bedplates cast & wrought,	Tools,
Lateral washers,	Ties and guard rails,
Sway "	Lead.

Roofs.

Main rafters,	Laterals.
Lower chord,	Sway struts,
Suspenders,	" rods,
Pins,	Knee braces,
Eyebars,	Track beams,
Purlins,	Ventilator frames,
Wall or bedplates,	" braces,
Anchor bolts,	Bolts and rivets,
Columns,	Paint.

Dimensions for Inspectors' Use.—Be careful to give the measurements required by the inspector in checking up the work, so that he need not be compelled to stop and add up rivet spacing, etc., to get at the lengths required.

Pin Grips, Etc.—Follow closely the rules given herewith for figuring pin grips. A pin a little too short may cause great delay and expense in the field.

Rules for Calculating Grip and Packing for Truss Pins.

1. In general allow 1-16 in. excess in thickness of each bar or rod on pin.

2. Allow 9-16-in. for heads of ¾-in. rivets, and ¾ in. for heads of ⅞-in. rivets, unless flattened or countersunk, in which case the exact thickness of head will be shown on the drawing.

3. In addition to the allowance in Section 1, make ⅛ in. additional allowance on each side of the chords or posts when bars pack outside against edges of angle, to allow for overrun of angle or irregularity of cut if angle has to be notched.

4. Where ½-in. collars are put between two adjacent parallel bars, no allowance need be made for clearance of collar; but in all other cases allow from ⅛ in. to ¼ in., so as to make the width of collar come in quarter inches.

5. Allow ⅝-in. for two Lomas nuts and ¼ in. for one Lomas nut, in addition to allowances above. If one Lomas nut and one standard pin nut are used, no allowance need be made for the standard pin nut. But if two standard pin nuts are used, add ¼ in. to grip of pin, and use a ⅝-in. washer on each end of pin next to nut. (This does not apply to cases mentioned in Section 6.)

6. When a lateral rod, sway rod, strut or other connection comes on pin, and pin has to be turned down to receive it, make the distance from shoulder to thread equal to the exact thickness of the connection that comes on pin, and use a standard pin nut on this end. In case of bent loop or head, use a washer between nut and head, to make head pinch tightly against shoulder of pin. If strut connection comes between head and nut, this washer can be omitted, as the bent plate on strut answers the same purpose as the washer.

General Dimensions.—Mark plainly the dimensions giving the relative heights of floor beams and pin centers, top of stringer and top of floor beam, the distance of base of rail to masonry and from pin center to masonry. It is very annoying to attempt to check a set of drawings and find none of these important dimensions given.

Painting Instructions.—When the painting instructions are sufficiently brief, print them on one of the sheets, near the title.

Size of Rivets, Etc.—Take care that the sizes of rivets are not larger than the maximum size given for each section, that the holes are not too near the edges or ends, and that rivets are not placed where they cannot be driven.

Thick Angles.—Thick angles and Z-bars will always overrun in width, and the amount must be determined and allowed for.

Small Cards.—Make small cards for all work to be done in the machine and smith shops, using blanks provided for this purpose.

Erection Diagram.—When the general drawing is not made or is not used as an erection drawing, make a line diagram showing all the packings, etc., in the simplest and quickest manner possible. Give merely the information required by the erector, and do not confuse the drawing by any unnecessary lines or figures. Do not show any rivet spacing. The detail plans are furnished the erector for reference.

Erection.—To insure ease and safety in erection, observe the following general rules in making the drawings:

Points to be Observed in Order to Facilitate Erection of Work.

The first consideration for ease and safety in erection should be to arrange all details, joints and connections, so that a span may be connected, made self-sustaining and safe in the shortest time possible.

1. Make sections of top chord nearest the center of span with two pin-holes, and in skew bridges the section of top chord in each truss, having two pin-holes, must be opposite and in the same panel.

2. Top-chord sections with half pin-holes, having hinge plates on each section, are undesirable. When half pin-holes are used, when possible, only put hinge plate on one section, making it long enough to rivet or bolt to the adjoining section, when in place. Hinge plates to be arranged so as to give two full pin-holes in center-chord section, and to be put on the ends farthest from the center on the other sections, except in special cases when it is necessary to commence to raise spans from end instead of center.

3. Entering connections of any character should be avoided when possible, notably on top-chord connections, floor beam and stringer connections, splices in girders, etc. When it can be done, joints should be so arranged as to avoid having to put members together by moving them on end, as it is often impossible to do this.

4. It is not advisable to put two shoes on one bedplate, and if this is done, the plates should be made longer and anchor bolt holes slotted to allow for variations in the masonry.

5. It is of the greatest importance to allow ample clearance where members pack in chords, posts, etc.

Lack of proper clearance causes much trouble and expense, and greatly increases the risk of erection, by increasing the time in making a span safe.

6. When it can be done, the trusses are always connected first, before the floor system is put in, and floor connections should be arranged accordingly, unless, in special cases, local conditions make it desirable to put in floor system first.

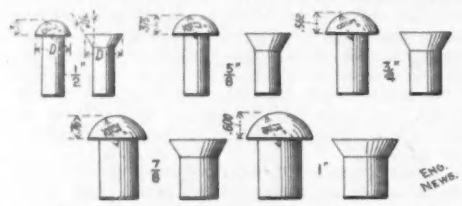
7. Adjoining spans should always be entirely independent; two spans should never be connected on same end pin, or on the same shoe, when the bridge is to replace an old structure. In the case of viaducts, the spans abutting on a bent should be so arranged that one span can be fixed in place entirely independent from the adjoining span.

8. Anchor bolt holes should be arranged so that the holes in masonry can be drilled, and bolts put in, after the span is swung. Make holes ¼ in. larger in diameter than bolts.

9. In putting in the bars and diagonals it is customary to connect them on bottom-chord pins first and then swing them into the chords or posts around the lower pins as a center. All rivets coming in the path of the bars swung in this way should be cleared.

10. Where adjustable rods pack close together the sleeve nuts should be staggered.

11. When girder spans of different depths abut on the same bent they should be arranged so that either



Button Head. Height of Head = Diam. of Rivet × 5/8" Rad. of Head = Diam. of Rivet × 1/2 + 1/8". To more B.H., add 1 Diam. of Rivet + 1/8", for each Time Diam. of Rivet is contained in Grip.
Countersunk Head. D = same as for Button Head, Angle of Countersink = 30°.

Fig. 2. Standard Dimensions of Rivets.

span can be set in place first, independent of the other.

12. All lateral bracing, hitch plates, rivets in laterals, etc., should be kept enough below the level of the tops of chords, girders, stringers, etc., so that the ties when in place will not foul them, as it is expensive to cut out ties to clear such obstructions.

13. Lateral hitch plates should either be shipped loose or riveted to the braces. If shipped on the girders they are usually broken off in unloading and handling. When slide plates project much beyond the flanges of girders, it is best to ship them loose.

14. Enough clear space should be allowed around all field rivets to admit of the button set (which is about 2 ins. square) being held in line of the axis of the rivet, or at right angles to the plate through which the rivet is driven, otherwise the rivet heads cannot be set down.

Rule for Allowances on Ordered Material.

Long plates, 60 ins. wide or over, allow 1 in.
Long plates, under 60 ins. wide, allow ½ in.

Pin plates and tie plates, allow ¼ in.
Lattice bars, allow 5/16 in.
Fillers, allow ¼ in.

Make ordered length of bent plates equal to outside measurement on bend. All bent plates to be made of steel.

Angles, 3 ft. long or under, allow ¼ in. Longer angles, allow ½ in.

Stiffeners, having fillers, allow ¼ in.

Stiffeners offset, make length equal to depth of girder.

Channels, allow ¼ in.

H beams, exact length.

Z, exact if on bevel, and allow ½ in. if ends are square.

Steel plates, 1 in. thick and over, order exact size, and note it on bill.

Tie-plates on chord and posts, run grain parallel with member, and allow ¼ in. in length.

Bedplates, 30 ins. square or less, order 15-16 in. thick before planing. Over 30 ins. square, 1⅛ ins. before planing, and plane to 13-16 in. and 1 in., respectively.

Never order the width of a plate in eighths.

Length of Material for Rivets.

Diam. rivet.	Ins. 1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3	3 1/8	3 1/4	3 3/8	3 1/2	3 5/8	3 3/4	3 7/8	4	4 1/8	4 1/4	4 3/8	4 1/2	4 5/8	4 3/4	4 7/8	5	5 1/8	5 1/4	5 3/8	5 1/2	5 5/8	5 3/4	5 7/8	6
¼ in.	1 1/8	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 7/8	3		3 1/8	3 1/4	3 3/8	3 1/2	3 5/8	4		4 1/8	4 1/4	4 3/8	4 1/2	4 5/8	4 7/8	5		5 1/8	5 1/4	5 3/8	5 1/2	5 5/8	5 7/8	6	6 1/8	6 1/4	6 3/8	6 1/2	6 5/8	6 3/4	6 7/8	7	7 1/8
⅜ in.	1 1/4	..	..	..	1 3/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	3		3 1/8	3 1/4	3 3/8	3 1/2	3 5/8	3 3/4	4		4 1/8	4 1/4	4 3/8	4 1/2	4 5/8	4 7/8	5		5 1/8	5 1/4	5 3/8	5 1/2	5 5/8	5 7/8	6	6 1/8	6 1/4	6 3/8	6 1/2	6 5/8	6 3/4	6 7/8	7	7 1/8
½ in.	1 3/8	1 1/2	1 5/8	1 3/4	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3 1/8	3 1/4	3 3/8	3 1/2	3 5/8	3 3/4	3 7/8	4	4 1/8	4 1/4	4 3/8	4 1/2	4 5/8	4 3/4	4 7/8	5	5 1/8	5 1/4	5 3/8	5 1/2	5 5/8	5 7/8	6	6 1/8	6 1/4	6 3/8	6 1/2	6 5/8	6 3/4	6 7/8	7	7 1/8	7 1/4
⅝ in.	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3	3 1/8	3 1/4	3 3/8	3 1/2	3 5/8	3 3/4	4	4 1/8	4 1/4	4 3/8	4 1/2	4 5/8	4 3/4	4 7/8	5	5 1/8	5 1/4	5 3/8	5 1/2	5 5/8	5 7/8	6	6 1/8	6 1/4	6 3/8	6 1/2	6 5/8	6 3/4	6 7/8	7	7 1/8	7 1/4
¾ in.	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3	3 1/8	3 1/4	3 3/8	3 1/2	3 5/8	3 3/4	3 7/8	4	4 1/8	4 1/4	4 3/8	4 1/2	4 5/8	4 3/4	4 7/8	5	5 1/8	5 1/4	5 3/8	5 1/2	5 5/8	5 7/8	6	6 1/8	6 1/4	6 3/8	6 1/2	6 5/8	6 3/4	6 7/8	7	7 1/8	7 1/4
⅞ in.	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3	3 1/8	3 1/4	3 3/8	3 1/2	3 5/8	3 3/4	3 7/8	4	4 1/8	4 1/4	4 3/8	4 1/2	4 5/8	4 3/4	4 7/8	5	5 1/8	5 1/4	5 3/8	5 1/2	5 5/8	5 7/8	6	6 1/8	6 1/4	6 3/8	6 1/2	6 5/8	6 3/4	6 7/8	7	7 1/8	7 1/4
1 in.	1 7/8	2	2 1/8	2 1/4	..	..	..	..	3	3 1/8	3 1/4	3 3/8	3 5/8	3 3/4	4	4 1/8	4 1/4	4 3/8	4 1/2	4 3/4	4 7/8	5	5 1/8	5 1/4	5 3/8	5 1/2	5 5/8	5 7/8	6	6 1/8	6 1/4	6 3/8	6 1/2	6 5/8	6 3/4	6 7/8	7	7 1/8	7 1/4	7 3/8	7 1/2	7 5/8	7 3/4	7 7/8	8	8 1/8
1⅛ in.	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3 1/8	3 1/4	3 3/8	3 1/2	..	..	..	..	4 1/4	4 3/8	4 1/2	4 5/8	..	..	..	..	5 1/4	5 3/8	5 1/2	5 5/8	5 3/4	..	..	6 1/4	6 3/8	6 1/2	6 5/8	6 3/4	..	7	7 1/8	7 1/4	..	..	..	..	8	..

Add for rivets in flanges of angles over 5/8 in. thick, ⅛ in. to above lengths. Subtract for rivets going through wood (purlins) ⅛ in. from above lengths. For countersunk rivets of 2 ins. grip and under, add diameter of rivet for each additional inch, above this add ⅛ in. extra. Deduct ⅛ in. from above lengths for field rivets over 1½ ins. grip. To all grips add 1-32 in. for each junction between surfaces.

AMERICAN TYPES OF MOVABLE DAMS AND THEIR DEVELOPMENT.

By Lieut. Hiram M. Chittenden, Corps of Engineers, U. S. A.

The conditions to be fulfilled by a successful automatic water gate have been stated to be: "That the pressure of the water, standing or flowing, shall furnish the power by which the dam is erected or removed"; and "that, notwithstanding the requisite solidity of the structure, it must be manageable with a slight power, for which only a few men and a short time are required." In other words, since the necessity for a dam presupposes a fall in the stream where it is built, and, consequently, the presence of an available water power, it is required so to utilize this water power in the operation of the gates as to dispense with the plant ordinarily used for that purpose. A still further qualification is, perhaps, necessary, in order properly to restrict the application of the term "automatic water gates." Lock gates may be, and often

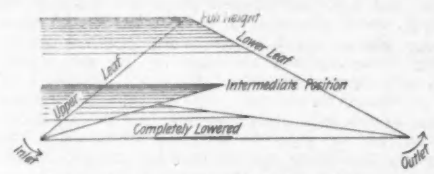


Fig. 1. American Bear-trap Gate.

are, operated by the water-power which they render available, and they would thus literally fall within the above definition. But, in such cases, the water acts only indirectly upon the gate, whereas, in the form of gate which we purpose here to consider, it acts directly, without the intervention of machinery.

There have been many attempts to devise a gate which will satisfy these conditions, as, for example, the Desfontaines and Cuvinot drum wickets, the Krantz Ponton wicket, the Brunot gate, and the Petididier counterpoise gate. But the only devices which as yet promise a satisfactory solution of the problem embody in direct or modified form the principle of what is known as the American bear trap gate.

The essential features of this gate are two leaves, built across the sluice which the gate is to close, and fastened by horizontal hinges to the bottom of the sluice at right angles to its axis. When the sluice is open, the leaves lie in a horizontal position, the up-stream leaf overlapping the other a certain portion of its length. When the gate is up and the sluice is closed, the form of the gate is that of a triangle, of which the three sides are the two leaves and the bottom of the sluice between the hinges, and of which the apices are the two hinges and the point where the leaves abut against each other. The space within the triangle is a chamber, which is filled with, or emptied of, water by means of valves or wickets under control of the operator of the gates. Fig. 1 shows the gate when at full height, when partly lowered, and when completely lowered.

The operation of the gate is extremely simple. To raise it, the outlet from the chamber below is

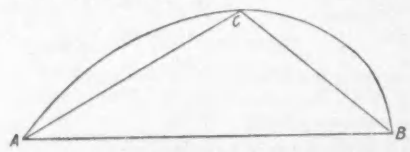


Fig. 2. Curve of the Old Bear-trap Gate.

closed, and the inlet above is opened. Water fills the chamber and presses against the lower surfaces of the leaves. Since the water has access also to the upper surface of the upper leaf, the pressure from below upon that leaf is neutralized. On the lower leaf there is no such counter-pressure, and the pressure on the lower surface, therefore, tends to raise the lower leaf and also the upper leaf, which rests upon it. This it will do in a properly proportioned structure, and will carry the gate to a height limited only by the dimensions of the leaves. To lower the gate, the water from above is cut off and the lower valves are opened, so as to empty the chamber into the pool below. The sustaining pressure on the lower leaf is thus withdrawn, and the pressure of the pool above is thrown upon the upper leaf. This pressure forces the leaves back into their horizontal position, leaving the sluice free for the passage of water.

The differences between the old "bear-trap" and its recent modifications relate mainly to the method by which the pressure on the upper leaf is made to lower the gate. An examination of the various forms will make these differences plain and will show the relative advantages of each.

The American bear-trap gate seems to have been devised, or at least first used, in 1818, by Josiah White, a Philadelphia merchant, and it was used on the Lehigh river, to facilitate down-stream navigation from the anthracite coal regions. Later it was largely utilized in the timber regions of Pennsylvania, for the purpose of flooding logs down stream where up-stream navigation was not desired. It has been introduced into a few works of navigation, but hitherto with only indifferent success, and it may now be considered as definitely abandoned in favor of its recent improvements. In deference, however, to the place which it holds as the first step in the evolution of an important mechanical device, and also because it has already had a useful history, it will be worth while briefly to examine the theory of its operation.

Two conditions are necessary for the successful operation of the old "bear-trap" gate. First. There must be such a proportion between the length of leaves and the distance between the hinges, that, when the gate is being raised, there shall be a preponderance of the upward over the downward hydraulic forces acting on the leaves just as they are beginning to rise from a horizontal position, no matter how small the initial head may be. Second. The angle between the leaves, when the gate is at its full height, must be such as not to prevent the leaves from moving freely upon each other when the gate starts to fall. It will be observed that in both these conditions we provide only for the case of initial movement. When the gate is once under way, either rising or falling, the preponderance of the moving over the retarding forces rapidly increases. A study of the gate shows that any set of valves for the leaves, which will satisfy the first condition, will satisfy the second also. We need, therefore, consider only the first.

Without going through the somewhat tedious mathematical details of the discussion, we may graphically express their result in what we shall here call the curve of the old "bear-trap" gate. It is shown in Fig. 2 and is accurately drawn to scale.

The meaning of this curve is, that any set of leaves constructed upon A B as a base or distance between the hinges, which, at full height, has its apex within the curve, A C B, will satisfy the foregoing conditions. The values of the two leaves corresponding to the maximum head obtainable are:

Upper leaf, .5239, in terms of base as unity.
Lower leaf, .6821, " " " " " " "
Max. head, .3320, " " " " " " "

It will be observed that the curve is very flat at the top, and that the relative lengths of the two leaves may vary within considerable limits without sensibly affecting the head obtainable. In the deduction of this curve, the leaves were assumed to have the same specific gravity as water, an assumption very nearly correct in the case of wooden gates, and always possible of realization in a structure made of iron or steel. An ample factor, of safety was also allowed for overcoming initial resistances to the motion of the gate.

Any gate of the old "bear-trap" pattern, constructed from dimensions taken from this curve, and with a specific gravity as above assumed, will rise under a very slight initial head. Hitherto the relative length of leaves generally adopted have been such as to require a considerable auxiliary head in order to start the gate. Lagrene recommends a small weir for this purpose, just above the gate and of a height equal to about one-fifth the total height of the gate. With proper proportions in lengths of leaves, no such auxiliary head should be necessary.

The faults of the old "bear-trap" were too numerous and important for it ever to become a very practical device. The overlap of the upper leaf

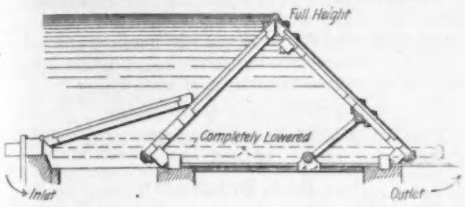


Fig. 3. Carro System; Gate Raised.

upon the lower is a serious defect, for it necessitates the lifting of a considerable weight of water, which should be effective only in raising the gate. The head obtainable is only one-third the total length of sluice, too small for an economical structure. The great length of the leaves in proportion to the head, subjects them to a heavy strain and largely increases the cost of construction. The sliding friction between the two leaves is an objectionable feature, and one liable to render the smooth operation of the gates a difficult matter. When the gate reaches its maximum height, it is brought to a sudden stop. This subjects it to great strain and in practice has sometimes resulted in destruction of, or serious damage to, the gate. With a wide sluice the leaves will not rise uniformly, one end generally going up faster than the other. This defect is liable to produce serious complications. Finally, it has been found in practice that driftwood carried over the gate is liable to lodge in the exterior angle between the two leaves and thus make it impossible to lower the gate. These and other minor drawbacks are of so radical a nature as to make it doubtful that even with the most careful construction, this form of gate can ever take rank as a safe and reliable device. Fortunately, certain recent modifications have almost entirely eliminated these defects and have placed the gate fully within the domain of practical engineering.

The first important step in advance was a gate built on what is known as the "Carro System" (Fig. 3). The essential improvement, which we wish particularly to note, is the hinge at the apex. By this change the overlap in the old pattern was

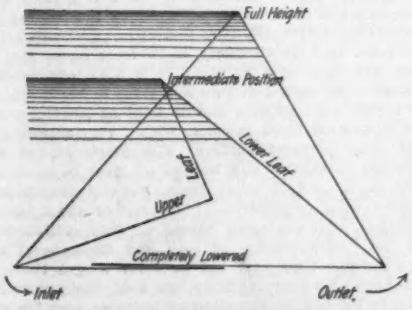


Fig. 4. Parker Gate.

done away with, as was also all sliding friction between the leaves. But the arrangement by which the upper leaf is compelled to slide back against the pressure of the head of water introduced another defect which neutralized the advantage resulting from the hinge at the apex.

The next step covered the whole ground down to the present time, and, barring the lesser details of construction, which experience alone can satisfactorily determine, gave the gate a form which in all probability it will retain. This modification was invented by Thomas Parker, of Menominee, Wis., and is known as the Parker gate. It retains the two hinges of the old "bear-trap," the Carro hinge at the apex, and makes the upper leaf in two sections joined by a fourth hinge (Fig. 4). The upper leaf thus folds in upon itself, so that when the gate is down, the order of superposition is: (1) The lower section of the upper leaf; (2) the upper section of the upper leaf; (3) the lower leaf. It is at once apparent that this improvement has eliminated all the defects, just enumerated, of the "bear-trap." There is no overlap at the apex; the head obtainable for the same length of sluice is over twice as great; there is no sliding friction; the gate can never be brought to a sudden stop when it approaches its full height, but comes to rest gently; the leaves must, of necessity, rise uniformly; their shorter length greatly diminishes the strain upon them and correspondingly increases the economy of construction. In short, as already stated, it places this form of gate fully within the possibility of important practical use.

The analysis of the Parker gate is based upon different conditions from those which obtain in the case of the bear-trap. There is no active hydraulic force in the Parker gate resisting upward motion. The raising of the gate is, therefore, simply a problem in multiplication, given the weight of the gate, the area of the lower leaf, and the effective head. In lowering the gate also, the critical point is not, as in the old pattern, when the gate begins to move. The hinged upper leaf develops an enormous downward force as soon as pressure is thrown upon it, although this rapidly diminishes as the angle between the sections decreases. But it is found that if the upper section of the upper leaf has a length beyond a determinate proportion of the length of the lower section the gate will not completely

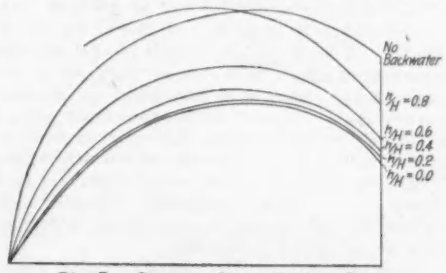


Fig. 5. Curves of the Parker Gate.

lower. In fact, in no gate of this pattern yet built have the dimensions of the leaves been such that the hydraulic forces alone were sufficient to lower the gate. In one instance it was found necessary to apply an auxiliary weight of 7 tons of iron to the crest of the gate. This weight, which increases the initial head necessary to start the gate, when it is to be raised, is wholly unnecessary in a properly proportioned structure. It has been found, also, that the difficulty is aggravated by the backing up of water below the gate, and that a gate which will lower where there is no back-water may fail to lower if there is any.

As in the case of the old "bear-trap" pattern, we shall here give the results of the analysis of the Parker gate in the form of curves (Fig. 5), with separate curves for the various stages of back-water, expressed in terms of the maximum head obtainable. The meaning of these curves is that any set of valves for the leaves of a Parker gate, which will satisfy the necessary geometrical condition: Lower leaf × lower section of upper leaf—upper section upper leaf = base, and which at full height does not rise above the curve corresponding to the particular condition of back-water, will lower under the action of the water pressure alone. In this work, as in that pertaining to the bear-trap gate, only hydraulic forces are considered, the leaves being supposed to have the same specific gravity as water.

It will be seen that the maximum head obtainable with the Parker gate, expressed in terms of length of sluice taken as unity, is 0.682, as compared with 0.332 for the old "bear-trap." A comparison of these curves with the position of the apices of some existing gates will readily show why the builders could not make them fall without the use of auxiliary weights. (See Fig. 6.)

The Parker gate developed one defect which, however, is easily gotten over by an auxiliary device. In the angle between the sections of the upper leaf, drift is liable to accumulate and prevent the complete lowering of the gate. To avoid this, an open leaf, hinged to the apex of the gate and sliding on the bottom of the sluice, is introduced. As this leaf plays no essential part in the operation of the gate, but acts solely to fend off drift, it is called an "idler." Since no pressure comes upon

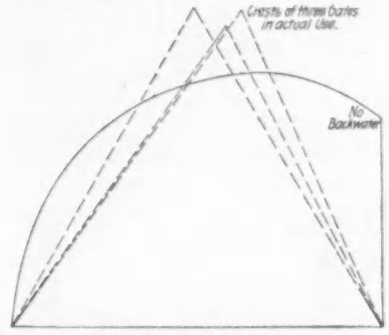


Fig. 6. Parker Gate.

the idler, the sliding friction at the foot need not be taken into account.

The next step in the development of the automatic gate is what is known as the Lang gate, after its inventor. It undertakes to make the idler an essential part of the gate. It replaces the upper section of the upper leaf by chains or rods, and the idler of the Parker gate by a solid leaf hinged at the apex and sliding on the lower section of the lower leaf (see Fig. 7). It is thus a combination of the Carro and Parker systems. Of this latest modification, it cannot be said that it marks any advance. The re-introduction of sliding friction is a distinct step backward, and this is at once apparent in the results obtained from mathematical analysis. Although this analysis has not yet proceeded far enough to make possible the presentation of a full set of curves, it clearly indicates that the Lang gate is inferior to the Parker in efficiency. The principal advantages of the Lang pattern are the doing away with the idler of the Parker gate, and the increased facility of access to the gate chamber. But it is very doubtful if these advantages will compensate for the radical defect just noted.

In connection with the government project for improving the Falls of the Ohio River at Louisville, Ky., and in illustration of the foregoing analysis, an elaborate model, in Portland cement mortar with plateglass sluiceways, exhibiting the three forms of gate above described, was built at the locks of the Louisville and Portland Canal in the winter of 1894. Incidentally it served the purpose of demonstrating the practicability of replacing the ordinary lock gate on canals by the automatic gate. The obvious difficulty in the application of this gate to lock use is the impossibility of getting an initial head with which to start the gate when it is to be raised. If boats are to pass over the gate, there can be no difference of level between the

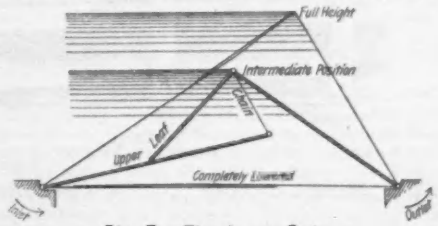


Fig. 7. The Lang Gate.

pools above and below. How, then, to lift the gate high enough to create a head to carry it the rest of the way was not readily apparent.

But this difficulty is easily gotten over in the following manner: Make the upper gate lighter than water. Its own buoyancy will then lift its crest above the surface, and the resulting difference of level in the pools will do the rest. To cause this gate (which is lighter than water) to fall to a horizontal position, connect the chamber by a conduit with the pool below the lower gate. It is thus

always possible to exhaust the chamber, and the pressure of the water on both the upper and lower leaves ensures the proper lowering of the gate.

In the lower gate these conditions are exactly reversed. Since the chamber can never be exhausted below the level of the lower pool, the gate must be heavier than water, so that it will fall of its own weight. To lift it, connect its chamber by another conduit with the upper pool. The whole head of the locks system is thus rendered available to raise

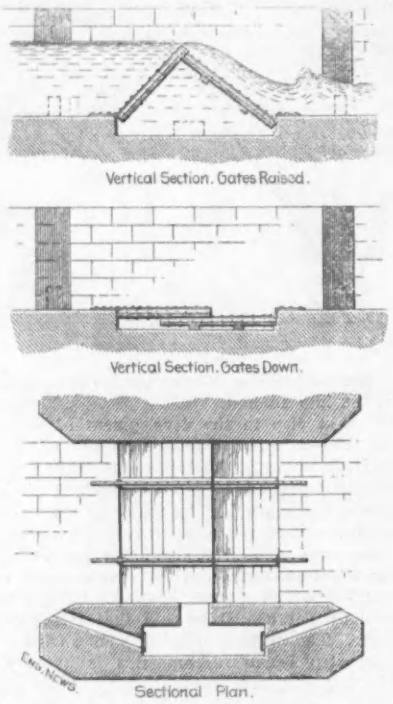


Fig. 8. American Bear-trap Gate.

the gate. As soon as it is lifted far enough to create a head in the pool immediately above it, the connection with the upper pool is cut off and the normal operation of the gate is resumed. Therefore, given two conduits, one connecting the upper pool with each chamber, and the other connecting each chamber with the lower pool; and given also an upper gate lighter, and a lower gate heavier, than water, with intermediate gates of any desired specific gravity; the automatic gate will fill all the conditions of lock service.

It is, of course, unsafe to predicate the successful working upon a large scale of any device on the fact that it works successfully on a small scale. But, in the case in hand, the perfect operation of a model in which only one of the gates is of the best pattern, and in which that gate is not built with theoretically correct dimensions; and the successful operation, upon a large scale, of these gates used singly, even when constructed upon defective principles; together with the fact that, in a system of locks, the conditions for successful operation are the best that it is possible to obtain anywhere; create a strong presumption in favor of the adaptability of the automatic gate for locking purposes.

The question of choice between the old and new methods thus becomes essentially one of economy—economy in construction, in operation, and in commercial use. In the matter of construction the element of cost, which at once suggests itself as of importance in the new system, is that of building the conduits along the locks. But, if this is done, as it would be while the lock walls are being built, it would involve no very great expense. One conduit is subject to no water pressure other than that from emptying the chambers. No special provision for strength in its construction is, therefore, necessary. The other conduit must resist a pressure due to a head of water equal to the total fall of the lock system. A cast iron pipe, like a large water main, would answer every purpose and its cost would be moderate. Certainly the entire cost of these conduits could not equal that of the machinery, well holes, tunnels, culverts and other appurtenances of the ordinary lock system.

As to the gates themselves, the anchorage and hinges of the new system could scarcely be as expensive as the costly special masonry work for the gate recesses and the mitre sills of the old. Incidentally affecting the cost may be mentioned the fact that the strains in the new gate are much simpler and easier to determine than those of the ordinary gate. Compressive strains in the old system are replaced by tensile strains in the new, while transverse strains could never be as great in the new as in the old. A general reduction in the amount of material required for construction ought, therefore, to be possible.

In the matter of relative cost of operation there can, of course, be no question of choice. By making the head of water perform directly what is now done by means of steam, water, horse or man power, with more or less complicated machinery, and generally a considerable force of employees, would mean a saving of great importance. In fact, there is reason believe, that as one or two operators in a switch tower handle the switches for an extensive railroad yard, so one or two operators, centrally stationed, might manipulate any number of lock gates which are likely to be built in one locality.

Besides the saving in the cost of operation, a more important saving would result in the increased speed of moving commerce through locks. In the present system, it is necesary, in carrying a boat past a particular gate, first to bring the pools above and below the gate to the same level, and then to open the gate. The necessary time for opening must be added to that for levelling the pools. With the automatic gate, the opening is part of the operation of levelling, and when the water of the two pools is at the same height the gate is open. Even the levelling can be done more rapidly with the new system, for there would be no restriction upon the flow of water over the gate, except the disturbance to boats in the pool below. In the case of ordinary gates, as the pools approach the same level, the flow, which varies directly with the difference of level, constantly diminishes. But in the case of the movable gate, by letting it fall more rapidly in proportion as it descends, the flow between the pools can be kept at a constant or increasing rate almost to the last. These considerations indicate that in the matter of expense, both in construction and operation, and in the movement of commerce, the advantage would be with the new form of gate.

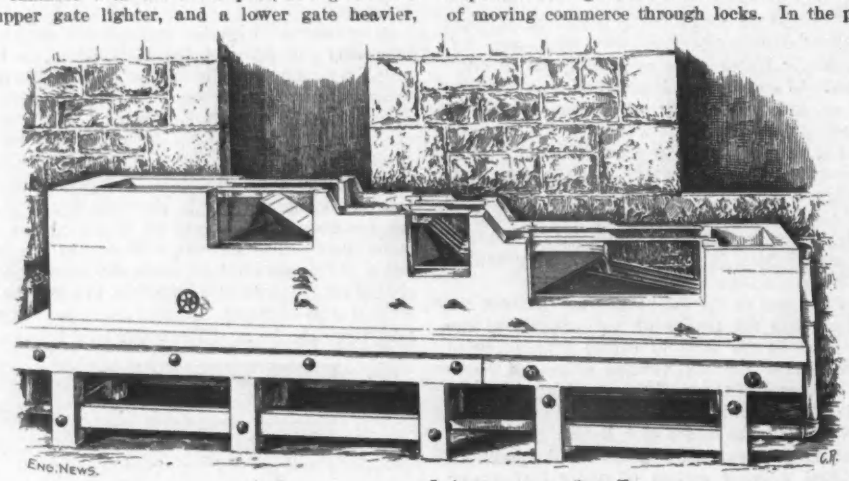


FIG. 9. MODEL CONCRETE LOCK, COMBINING THE LANG, PARKER AND BEAR-TRAP GATES.

Another important advantage of the new gate over the old may be mentioned. When, as in the case of the Louisville & Portland Canal, sudden floods in the river at times force ice or driftwood into the canal, the facility of moving it through the locks would be vastly increased by the use of the movable gate. The instances are not infrequent, in the case of the above-named canal when traffic has been suspended for more than 24 hours, while ice or drift has been cleared out of the canal by the tedious and often very difficult method of locking.*

PRESERVATIVE COATINGS FOR IRON WORK.**

By A. H. Sabin.***

The way in which this matter of preservative coatings for iron came to my attention with special force was this. Our firm was consulted a couple of years ago with regard to a preservative coating to be applied to a new 36-in. steel water supply main for Rochester, N. Y. We advised the engineer in charge that the only way in which he could preserve that pipe, with a prospect of permanence, was to dip it in baking japan and bake it. The coating we applied to that pipe was a special baking japan, made expressly for the purpose, and differed from the ordinary baking japan. That was the beginning of our applying the preservative coatings on a very large scale. We had been making baking japans for 50 or 60 years, but work on such a scale as that had never been undertaken before.

What I have to say is based upon the above work and upon the preparation of ordinary air-drying coatings, which are required to supplement that kind of work, and used for painting bridges and other structural work, not fine finishes, not what you would call black rubbing japan, but simply preservative coatings.

Permanent preservative coatings for iron belong to two classes: In the first the coating is made hard and firm by a process of baking; in the second, it becomes hard at ordinary temperatures by oxidation or by evaporation of a solvent, or by a combination of both these processes, or in some cases by mere cooling from a heated and fused condition.

The first class consists of enamels and of japans. Enamelling may be briefly described as a process of covering a metal with a glaze essentially similar in its constitution and properties to glass, and possessing all the advantages and disadvantages of that substance; the glass is melted by intense heat on the surface of the metal, to which it adheres. The process is rather costly, and the coating thus obtained is very handsome and resists the action of solvents well, but is brittle and easily chipped off. Japans are intermediate between enamels and ordinary varnishes. A properly japanned surface has a power of resistance to solvents approaching that of an enamel, while it greatly surpasses that in the tenacity with which the coating adheres to the metal, allowing the latter to be hammered and bent, and its elasticity is in most cases greater even than that of a varnish. It is also intermediate between a varnished surface and glass in hardness, being harder than gypsum and as hard as marble. As a rule japans are black in color, with a very smooth and apparently polished surface. The black japans are made up of asphalt and linseed oil as a base, mixed with more or less copal resin, usually Kauri, and thinned with turpentine. It is true of them, as of varnishes, that the more linseed oil they contain and the less driers (oxides of lead and manganese) the more durable they are; but in order to get them to bake hard at a comparatively low heat, the proportion of oil is frequently decreased as much as possible and the amount of driers is increased.

When a film of linseed oil is exposed to the air it rapidly hardens by the absorption of oxygen from the air. This process leaves the film full of minute pores; hence this film, while durable, is not a good protection, because it is not continuous. It requires a good many thin coats, because each coat tends to fill up the holes and pores in the coat which is already dry be-

* The analytical work, of which some of the results are presented in this article, has been done conjointly by the writer and Mr. A. O. Powell, U. S. Assistant Engineer, St. Paul, Minn.

** Slightly condensed from a paper read before the New England Railroad Club, Jan. 9, 1895.

*** Chemist for Edw. Smith & Co., Varnish Manufacturers, New York city.

neath it. The addition of a perfectly neutral substance in the form of an absolutely impalpable powder—such as lampblack—has a tendency to fill up these pores, and hence the well-known fact that lampblack and linseed oil make a paint which will last for a generation; but it is excessively slow in drying for the same reason. Varnish resins are mixed with oil for the same and other purposes, and so are the various kinds of asphalt. As asphalt is a substance which consists mainly of carbon, holding a position between mineral oil and bituminous coal, and is very permanent when protected from the air, and as it is, moreover, at moderately high temperatures, a liquid, and dissolves freely in linseed oil and melted resins, it is very well suited for the purpose of hardening and solidifying the mixtures in which it is used. The turpentine is used to dilute the mixture, and is all, or nearly all, lost by evaporation during baking. I see no great objection to using benzine in this way; it is all practically driven off. Benzine hurts the flowing qualities of the varnish tremendously and turpentine is better in a high-class varnish. Where the work is going to be subjected to great heat, I don't know that benzine does any hurt.

When a piece of metal is dipped in japan, and then baked for several hours in an oven, the hardening, which is usually accomplished slowly at ordinary temperatures, takes place rapidly and more perfectly; the film is kept, during this process, in a semi-liquid condition, and all the pores and inequalities in the coating are obliterated. If there are any minute parts of the surface which were not originally covered by the liquid, these are gradually covered by the hot fluid slowly creeping over and in intimate contact with them; and the result is a film, absolutely and continuously adherent to this metal, hard, tough, and with a smooth and shiny surface, free from pores or irregularities, and well calculated to resist the atmospheric and other agencies which tend to attack it.

It must be obvious that the resisting powers of such a coating will depend on its composition. The cheaper grades are made with coal tar instead of asphalt, with common resin instead of copal gum, and with benzine instead of turpentine; while a heavy mineral oil sometimes entirely or in part, replaces linseed oil. These may present as good an appearance when new as the very best japans, but are of inferior durability. Asphalt itself is but a generic name applied to mineral substances of various characteristics; and it is important, for durability and for resisting power, to have the best materials. Japanned iron sign-plates, door-locks, and latches are well known to have resisted rain and dirt and wind for many years; the value of the coating has, for many years, been well recognized and undisputed; but until recently it has been assumed that it is applicable only to small objects. Now, however, it has been proved that it is applicable to very large work, and that it is an economical coating, easily applied, giving uniform and excellent results.

It is perfectly well known to those who are experienced in such matters that the durability of an ordinary oil-and-gum varnish is greatly increased by baking—is, in fact, increased several times. It is therefore proved that the process of baking is in itself of great value, probably because, as already stated, it insures the intimate adhesion of the covering and the base, the continuity of coating, an absence of porosity, and hard-glazed surface which resists abrasion. In addition to this is the fact that the process of baking enables the operator to use a coating which is much more durable in itself than one which will dry hard at ordinary temperatures; for practical use it is indispensable that a paint or varnish shall dry hard within one or two days, while such combinations of material as require weeks or months to dry, and which are therefore much less subject to change from atmospheric influences can be used only in a baking process. These compounds we do, in fact, use for this purpose. It is thus evident that a suitable baking japan, properly applied, is the best known protection for metallic surfaces under all ordinary conditions.

One reason why this coating has never been used on large work is that its use has involved the evaporation of the turpentine or benzine with which it is thinned. This creates an enormous fire risk; not only a risk of fire, but also of explosions. This in itself is prohibitory; and further, the cost of this constituent, which is eventually all wasted, makes it expensive. We believe ourselves to be the first to avoid this difficulty, by making a compound free from any such thing, so that there is practically no fire risk in its storage or use, and the purchaser buys nothing but the very coating material itself. When we consider that this reduces the volume of the japan by about one-half, the great saving is evident. At the same time we are able to make a compound having the greatest durability of anything known to us.

This was what we recommended and what was used for coating the last half of the Rochester pipe line (14 miles of 38-in. steel riveted 5-16-in. pipe), which was dipped in our compound, and then put into an oven and baked at a rather high heat, 400° to 600° F., for several hours. This plan proved very successful, easily carried out, and economical. The coating that was formed by this process was a very perfect coating. The chief engineer in charge could not tell after the baking which was the top or bottom. It is easy to tell in a small piece, but every section looked like every other section; they did not have to recoat a single section.

The first part of that line was coated with the Californian "Maltha," a petroleum by-product, a sort of artificial asphalt, in which the pipe was dipped and then removed and allowed to cool. This is a very common practice. The objections to this are, that the mixture ought to be just hard enough and just soft enough, a certain mean sought to be obtained by adding to a harder product a varying amount of one containing more petroleum; but this balance is constantly being destroyed through the continual evaporation of the more volatile part, so that successive sections differ, and their coating, which is a thick and at first a very handsome one, flakes off, owing to abrasion, during transportation, and then the hammering, due to field riveting, and the passage of workmen through and over the pipe, knock off a still larger amount, until finally at least 20% of the surface is left uncovered. In the Rochester job several thousand feet in length of the Maltha-coated pipe had to be scraped and then painted, the original coating proving worthless.

Further, any such coating as this suffers continual deterioration when in use. The more volatile and soluble ingredients are gradually removed, leaving the more solid portions as an earthly coating, which offers on the interior, a good foothold for fresh-water algae and other plants and sponges, which gradually diminish the capacity of the pipe. The old 30-in. main at Rochester has in its 20 years of existence lost about 50% of its capacity from this cause. It is doubtful moreover whether the coating, after such deterioration, affords much protection to the pipe.

The pipe sections are dipped in a tank of this liquid, drained, put into a suitable oven and baked. The Rochester plant has an oven capable of taking twelve 28-ft. sections of pipe, each weighing 2¼ tons, and they got two charges out per day. The pipes were supported in a vertical position, the total height of the oven being 35 ft., and the drip was recovered and used again. The coating thus formed is very thin, hence a gallon of the liquid covers a large surface; it is absolutely continuous, protecting iron from muriatic acid, for example, for weeks or months; it is elastic and closely adherent, not being scaled off, even in the coldest weather, under the blow of a hammer; it really forms a skin over the iron. These pipes stood transportation on wagons during the winter without abrasion.

Besides the Californian "Maltha," other coatings belonging to the second class—those which become hard at ordinary temperatures—are ordinary oil paints of various kinds, and certain mixtures more or less resembling varnishes. The oil paints consist of some powdered pigment, usually a metallic oxide or carbonate, suspended in linseed oil or some inferior oil; some of these paints are sold at prices which preclude the possibility of using linseed oil. I know of one paint that is used a good deal, sold at 45 cts. a gallon. These paints are fairly durable, and some of them very durable on wood; but on iron they have not proved to be so, and experience has shown that the metallic oxide acts as a carrier of oxygen to the underlying iron, causing it to rust instead of protecting it. For this reason these paints have been unsatisfactory, and to a large extent have been abandoned. It is well known that linseed oil alone is easily attacked by sulphur compounds, and it is necessary, when a coating to resist sulphurous gases is wanted, to compound it properly with a suitable resinous ingredient. An ordinary oil paint is also more or less porous, and the iron underneath is observed to rust and then throw off the paint. There was a time when nearly all the iron bridges in this country were covered with these paints; but they have almost gone out of use, as the bridge engineers found they did not, in fact, give iron the protection which their successful use on wood surfaces seemed to promise. You all know that good iron paint on a freight car will last about as long as the car will, and that a corrugated iron roof painted with the same paint will not last more than three years. I think the reason is just this: A piece of iron without anything on it can be kept for a long time under proper conditions, but if you allow it to begin to get rusty, the rust corrodes it very fast, because that coating of oxide of iron acts as a carrier of oxygen to the layer underneath it and oxidizes that, and that the one underneath, and so on. With this oxide paint you put on a coating of iron rust, and it is the most suicidal thing you can do, and I believe that is the reason why the use of oxide of iron on iron work has so extensively gone out of use. Some have had better success than others; but as you go over the country you see that bridges are not painted with oxide of iron any more, and I think that is the reason.

Greater success has been obtained by the use of varnishes or mixtures intended to be of that sort, fluids, not holding pigments in suspension, but drying either by evaporation or oxidation, or both. Most of these preparations are only mixtures, and are compounded mainly of coal tar, dead oil, resin and benzine, sometimes with the addition of resin varnish and driers. Especially there has been a practice of coating the hot pipe with coal tar or coal-tar preparations; however good results may have in former times been obtained in England by this method, certainly it is not very successful here; personally, the writer of this doubts if it ever was of much value, but certainly the present methods of making coal tar, so different from the practice of 40 years ago, give a product which is sure to change rapidly. It is the common belief of all those most familiar with the subject that anything depending for its elasticity on coal tar or mineral oil cannot be durable, although it may be cheap.

As has already been said, no preparation which is used cold is as good as a suitable baked coating; but there are many places where baked coatings are not admissible; for example, railway and other bridges, iron roofs, and in general structural iron work, already in place; also the rivet heads, etc., of field-riveted work; in fact, there is and always must be a great demand for a coating which can be applied by a brush, and which will dry within a reasonable time in the open air. As it is not necessary to have for this purpose a very quick-drying substance, we should be able to make a preparation which shall possess very great durability.

It should be made with a pure asphalt, not a cheap grade, but such as is used exclusively in varnishes, and pure refined linseed oil as a base; it should be made by a skilled varnish maker, and be in no sense a mixture; it should be absolutely free from coal tar or coal-tar products, mineral oil, resin or benzine; it should be thinned with the best turpentine; it should be sufficiently soft and elastic not to chip off even under a blow in the coldest weather, and not softened, but rather hardened, by heat; it should not be affected by acids or saline solutions. It cannot be expected to last forever, but it may be more durable than anything which has been used for the purpose within our knowledge of the matter. It should not dry too quickly, so that it can be applied without skilled labor; it must be perfectly homogeneous, so that there is no waste in using it; it must not depend on heat for its fluidity, so that it may be used in winter or summer; being free from benzine, its storage and use are free from any unusual fire risk. After 10 or 12 hours it cannot be washed off by the severest storms, and it is fairly hard and dry in 36 hours, although it continues to harden for several days.

Such a coating may give a beautiful black finish, having neither a dead surface nor a high gloss, but resembling, at a short distance, a Bower-Barff oxidized surface, and is very suitable for either exterior or interior ornamental iron work, as well as for heavy structural work.

Varnish is different from paint in this respect: As soon as the turpentine has got out of the varnish, when you put on water it hardens it; when you put water on paint, it tends to wash it off. A properly-made varnish, whether made of asphalt or copal gums, is hardened by water, that is well known, and for that reason you can make a coating of this sort which shall resist a rainstorm before it gets dry, and while it is still tacky and partly wet to the finger, it will resist rain because water hardens it. It is not intended to make a smooth surface such as you would get on a panel, but it is a preservative coating. The bridge engineer does not admit that he varnishes his bridges, he paints them, and so to please him we call it a bridge paint; but it is really a varnish, and there is no pigment in it.

I would also call your attention to another point. I spoke of the importance of using a pure, refined linseed oil. It is just as important to use refined linseed oil in black varnish as white varnish. To get the color out of linseed oil is of small importance; the primary object is to get out a non-drying constituent, so that the oil will dry without loading it with driers. There is one thing in my experience in the varnish business which agrees with the experience of everybody else in that business, and that is, that every bit of drier which you put into a varnish or paint hurts it; and what we aim at is to make a varnish without any drier. We have not got to that point yet; and if anybody claims that he has got such a varnish, I should be a little skeptical about it. But in the last ten years varnish makers have reduced the drier a great deal, and have done without it by refining the linseed oil and getting the non-drying part out of the oil. By getting that out you accelerate the drying and improve the durability of your paint. Here are two bottles of linseed oil; one is Thayer's, a good standard raw oil, and the other is the same oil after it has been refined. Our way of refining linseed oil, as far as I know, represents the high-water mark in that process. We use the residuum to make driers, which are made of linseed oil cooked up with litharge, manganese, etc.

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The poling system of handling cars in terminal yards seems to be rapidly growing in popular favor. At the last meeting of the Central Railway Club the subject was thoroughly discussed, and the sentiment was practically unanimous that cars could be distributed by poling at much less cost, with much less yard room, and with very much less breakage, than in the old-fashioned way. At Kensington, near Chicago, the Michigan Central R. R. has established a freight yard where 1,500 to 2,000 cars are handled daily, and breaking a drawhead is a rare occurrence. On the Pennsylvania R. R. poling has been in use to a greater or less extent for some ten years, and the result of experience is that, with a properly-arranged yard and a crew familiar with the work, one switching engine will do twice to three times the work it would do under the old system. Of course, in the first introduction of the system, difficulties are apt to be encountered. The fact that the system reduces the number of crews tends to make the men oppose it and use such means as they can to make it a failure. Even where this is not the case, some time is necessary to familiarize the crews with the work and enable them to show a fair record. Making allowances for these things, however, it must be conceded that the poling system has had a remarkable success, and is now the system which good practice demands should be provided for wherever a large freight-distributing yard is to be laid out.

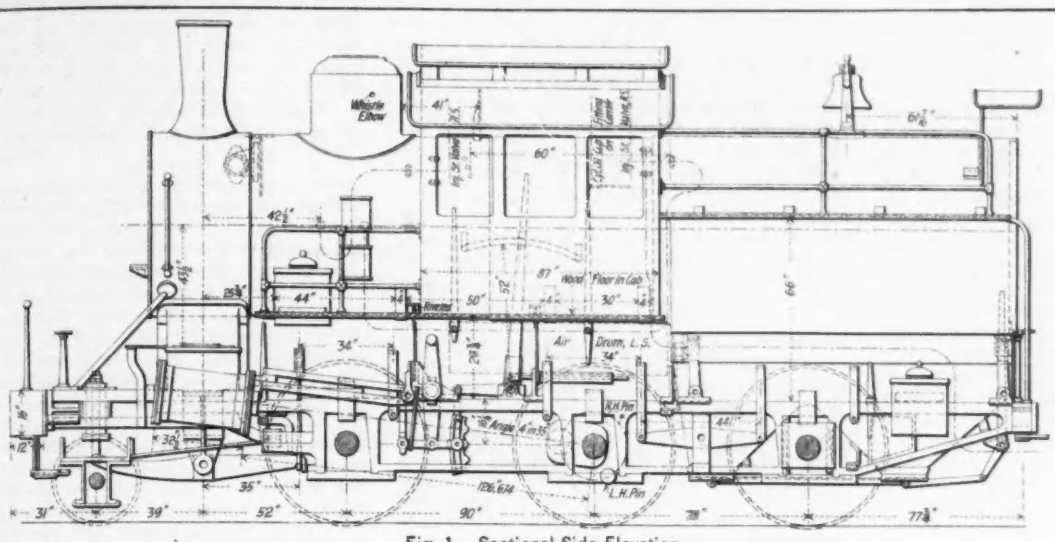
The interesting paper on the development of movable dams of the American type, presented in this issue, was prepared for this journal by Lieut. Chittenden at our special request. While many attempts have been made abroad, notably in France, to devise gates automatically operated and specially adapted to raising the level of water for slack-water navigation, the simplest form, and the one promising the most satisfactory results, seems to be the old American bear-trap gate. This gate was devised in the early part of this century to facilitate the transport of anthracite coal down the Lehigh River, and until the railways opened other lines of communication, crude as it was in application, it well fulfilled its purpose. Though it has since been largely utilized in the floating of logs down stream in the timber regions of Pennsylvania, there is little to be found in technical literature regarding its construction or operation, and the description given of its working will be new to the majority of engineers. The present investigation of automatic gates was instituted in connection with the government project to improve the navigation of the Ohio River, at Louisville, Ky. At this point locks are necessary to permit navigation in both directions, and considerations of economy in construction, and especially in operation, led Lieut. Chittenden to devise means for eliminating the inherent and important faults in the bear-trap gate, as originally used, and to attempt to adapt it as a substitute for the ordinary canal lock. What he has done in this direction, so far, is set forth in his paper, and his conclusions would seem to fully warrant a trial on a more elaborate scale. The cost of construction for canal and conduits is comparatively small, as there is little of the costly special masonry required in the usual lock; the water itself is made to do the work of steam or man power, and there would certainly be a saving in time in the passage of boats through such a system of locks. The increased facility in handling driftwood or ice brought to the locks by sudden floods is no unimportant consideration. To the best of our knowledge, this is the first time that the principle of this old American device has been scientifically and intelligently investigated or proposed for regular lockage purposes, and it is here shown that it has possibilities that were before unknown and which may lead to very important results.

In our last issue we had something to say concerning the McKaig bill, now before Congress, advocating a change in the methods of procuring plans for and erecting government buildings. But one of the best arguments yet advanced for a reorganization of this important bureau is the letter recently sent to Secretary Carlisle by Mr. J. M. Carrere, declining the offer of the position of Supevising Architect. Mr. Carrere clearly states his reasons for this action, and they are those of a wise and conscientious man. As at present organized, this bureau has a staff of about 150 men, whose duties are divided as follows: First, a legal department, having charge of all contracts, purchases of sites, deeds and all other legal matter relating to this department; second, an extensive system of accounting, burdened by a vast number of small accounts resulting from the maintenance and repairs of buildings; and third, the technical or drafting division, with its multitude of designs, computations of quantities, specifications, etc. The work to be performed is scattered all over the United States and is absolutely beyond the reach of any one man, except by proxy, and practically beyond his control. At the present time 115 buildings are in course of construction, ranging from a $2,000 appropriation, involving much detail and loss of time, to the $4,000,000 Chicago post office. About 250 buildings have also to be maintained and repaired, with most of the money appropriated expended in small amounts. This is the work over which the Supervising Architect is placed, and for which he is supposed to be responsible. Mr. Carrere finds the staff in charge in a most disorganized condition, with the personnel ill adapted to the class of work expected from it and working under cumbersome methods. But more than this, he finds that the Supervising Architect himself is legally merely a clerk of the department, appointed by the Secretary of the Treasury; and, though his responsibility is supposed to cover all of the above work, his authority is absolutely dependent on the Secretary of the Treasury and much of it is divided with heads of other departments. As Mr. Carrere well says: "Any man, no matter what his ability or his power for work and concentration, and no matter what conditions might be offered to him, even those of absolute responsibility with absolute authority, would have to devote himself either to managing the office, allowing the designing to be done by draftsmen, as at present, or to designing, allowing the office to be managed by heads of departments, as at present; and no man of ability, with a reputation to lose as an artist, would be presumptuous enough to accept the office, even if his duties were to be confined to designing, irrespective of any other work or responsibility, because it is absolutely beyond the grasp and the ability of any one man who has ever lived to imprint his personality upon this work, and much less to design it and study it himself." The remedy, for the architectural part of the work, at least, is that proposed by the McKaig bill, of dividing up this work and intrusting it to the best architects in the country, and leaving the administration of the bureau where it belongs, in the hands of the government. It is evident that no one man can intelligently and efficiently head this department as now organized; and it is a new system, not merely a new man, that is needed.

The methods of work in the office of the Supervising Architect of the Treasury Department have recently come up for discussion in connection with the proposed new post office building for Chicago. A bill appropriating $4,000,000 for this building is now before the Senate, it having already passed the House of Representatives. This new post office is urgently needed; the present structure, built some 20 years ago, is crowded to the limit of endurance; its plumbing and ventilation are of the poorest, and it is inconvenient in every respect in its internal arrangements. Besides this, the foundations are settling in a manner which endangers those who occupy and use the building, and large cracks in the masonry indicate that the building is likely to be a mere ruin in a few years. Everything calls for haste in the erection of the new building, and, of course, the enterprising reporter has rushed to get the views of the Supervising Architect regarding the time required for its construction. According to this official, as quoted in the published interview, we find that plans and specifications cannot be prepared in six months, and that it will be "simply impossible" to erect the building in three years; that "this office has never done such a thing as to erect a $4,000,000 building in three years, and cannot do it now." When asked whether it could not be done if the modern steel type of construction was adopted, the reply was made: "This office does not believe in that type of building. It won't do for the government. The United States erects monuments. It would not be dignified for it to erect a steel building. The government puts up heavy masonry structures and puts them up to stay." Naturally the Chicago citizens, viewing the present crumbling structure, which shows every indication of not staying, and anticipating the makeshifts of the next three or four years, are indignant, and the newspapers have been saying various things about "fossilized bureaucrats" and "cheap draftsmen architects," to relieve their feelings. We admit that there is considerable reason for their wrath, but are not the people themselves largely to blame that such conditions are possible in our government architect's office?

The committee of the American Society of Civil Engineers, appointed to consider amendments to the Constitution presented at the last annual meeting, includes in its report one recommendation that seems to call for some comment. This is the proposed amendment to Art. III., Sec. 5, requiring that ballots on reconsideration of a rejected application for membership be signed by the voters. This amendment would abolish the secret ballot in such a case, and to exclude the applicant, 10 per cent. of all the votes thus signed must be in the negative. The present total membership of the society in all grades is 1,808, and of this number 1,189 have the right to vote and hold office. At the last election of officers of the society, under circumstances calculated to call out a full vote, the number of ballots cast was 709. But an average vote on applicants for membership is much smaller than this, say, 500 in all. As a consequence, it would require from 50 to 70 negative votes to reject a candidate on this second ballot.

Now, as a matter of fact, the majority of applicants for membership have more or less hard work in finding the "five references" among corporate members, required by the constitution; and the unfitness of the applicant for association with his fellow engineers must be notorious indeed if it should happen that 50 or 70 of the voting membership would be willing to sign their names to a negative ballot, upon "intimate personal knowledge" of this unfitness. Under the present system any one having valid cause to object to the personal or professional standing of the applicant is now called upon to state his objections in writing to the Board of Direction, as soon as the "blue list" shows him that


Whistle
Elbow
Cylinder Saddle
Steam Pipe
Throttle Valve
Steam Dome
Sand Box
Hand Rail
Hand Hole
Hand Rail Support
Hand Rail Stanchion
Hand Hole Cover
Hand Rail Knee
Hand Rail Support
Hand Rail Stanchion
Hand Rail
Hand Hole

such an application has been made. This opportunity and obligation seem sufficient now to exclude the very objectionable applicant, and would, in our opinion, better serve the purpose intended than would the proposed amendment. This amendment, while nominally referring the decision to an open ballot, actually makes it impossible to reject any man who has once passed the scrutiny of the Board of Direction, and has had his name placed upon the first voting list.

The committee states that the Board of Direction now carefully and rigidly investigates the standing, both personal and professional, of every applicant for membership, and does this to a greater degree than ever before in the history of the Society. This being the case, it seems that all the necessary safeguards are already provided, and we would suggest that the amendment be amended by making the decision of this Board, upon any rejected application, final and binding, wording the constitution in such a manner as to secure this effect. Every interest of the American Society of Civil Engineers requires that unworthy men should be excluded from its membership; but the same considerations demand that no worthy applicant should be denied admission merely from petty personal dislike or from even more unworthy motives. The Society reposes every confidence in its Board of Direction, and it could surely intrust this Board with the veto power proposed, and thus avoid a formal and, in our opinion, wholly unnecessary ballot.

The Council of the Institution of Civil Engineers in effect passes upon all applications, as the large and widely-scattered membership makes a letter ballot practically impossible. But the Institution demands that the "indorsers" of an application for membership shall be personally acquainted with the professional career of the candidate and have a full conviction of the qualifications upon which the application is grounded. This application must be signed by, at least, five corporate Members of the Institution, in the case of an original application, and by, at least, ten Members, if it is a case of transfer from Associate Member to full Member. This rule, strictly enforced as it is, has the effect of making members extremely careful in signing applications, and the whole membership is benefited accordingly. In the American Society of Civil Engineers, as every one knows, there is altogether too much indorsement on the grounds of pure good nature, or upon the previous signing of some personal friend. As a consequence, any one who can present some kind of a record, obtain the signatures of five good-natured members, and who is too obscure personally to attractive attention or negative votes, has a fair chance of being elected. This is a matter that should be more strictly regulated than it is at present, and the members indorsing an applicant should be held by the Board of Direction to a very strict accountability for their statements concerning the personal and professional qualifications of the candidate; for upon this indorsement the Board is forced to lay very considerable stress in most cases. A man who slips into the Society under these conditions may grow up to his requirements and eventually prove a worthy member; but it is much better for the general standing of the Society that he pass through this developing process before he applies for membership at all. A greater sense of responsibility in this matter of indorsing applications is apparently necessary among members; and if each member does his full duty in this respect the Board of Direction can be depended upon to do its duty, as before intimated.

Quite a number of three-cylinder and four-cylinder locomotives have been brought out during the past few years, especially by European designers, the object generally being either to permit compounding or to secure a more uniform turning moment than is given by the ordinary engine, with its cranks set quartering, and very recently the four-cylinder plan has been taken up with the idea of securing a perfectly-balanced engine. In the articles on counter-balancing in our issues of Jan. 10 and 17, it was shown that if the counter-balancing is properly done and proper attention is given to avoiding excess of weight in the reciprocating parts, a locomotive will ride well and yet will not have an excessive hammer blow on the rail. If this fact is borne in mind, the practical difficulty of introducing a new type of locomotive which would be encountered by those designers who would multiply the cylinders of a locomotive, and necessarily in so doing increase its complication, will be evident. This difficulty is increased, moreover, when a cranked axle is added to the design. On the other hand, it is undeniably rather difficult to put a single low-pressure cylinder of sufficient size on a heavy freight locomotive and not make an awkward job. For hauling heavy trains on steep grades it is doubtless true that the more even turning moment of a three-cylinder simple locomotive is an advantage, and the lighter and more uniform exhaust ought to make a marked difference with the tearing of the fire. As for compounding, some of the best records of economy due to compounding have been obtained from engines working on heavy grades.

On another page of this issue we describe, at some length, the three-cylinder system successfully introduced by the late Mr. John B. Smith on the Erie & Wyoming Valley R. R., as the result of his experience with the substitution of three for two cylinders on stationary winding engines, used in hauling coal trains up inclined planes. These locomotives are non-compound, and are especially notable from the fact of their having a cranked axle, which is a very uncommon feature in American locomotive practice.

Multi-cylinder locomotives are much more common in Europe than in this country, but the European engines are almost invariably on the compound system, the only exception which we now recall being the four-cylinder simple engine designed by an English engineer and exhibited at the Columbian Exposition (Eng. News, April 13 and Sept. 28, 1893). This engine had four driving wheels, not coupled by side rods, the front driving axle being driven by inside cylinders and the rear axle by outside cylinders. The London & Northwestern Ry., of England, has in service a number of passenger and suburban engines, built on the three-cylinder compound system, designed by Mr. F. W. Webb (Eng. News, June 26, 1889, and Sept. 28, 1893), in which the high-pressure cylinders are outside and drive the rear driving wheels, while the large low-pressure cylinder, under the smokebox, drives the crank-axle of the front driving wheels. In these engines side rods are not used. An Indian three-cylinder compound was described in our issue of June 9, 1892. In France, Switzerland, Hungary and Russia the four-cylinder compound system is meeting with considerable favor, but while in the latter countries the cylinders are usually placed tandem (Eng. News, Feb. 6, 1892; April 6, 1893, and May 11, 1893), so that there is only one main driving axle, as in two-cylinder simple engines, in the two former countries the practice is usually to place the cylinders independently, each pair driving a separate axle. This arrangement is used for eight-wheel and ten-wheel express engines, such as the eight-wheel engine exhibited by the Northern Railway, of France, at the Columbian Exposition (Eng. News, Sept. 28, 1893), and the somewhat similar engine, briefly described in our issue of July 26, 1894; and it has also been applied to some heavy consolidation freight engines on the Paris, Lyons & Mediterranean Railway, which we shall describe in a later issue. The Northern Railway engine has side rods. In this country, although the four-cylinder compound system has been very extensively introduced, the cylinders are invariably in pairs, and the trailing drivers are driven from the main drivers by parallel rods, as in an ordinary locomotive. This is the case in the Vauclain system (Baldwin Locomotive Works, Eng. News, Feb. 20, 1892, and June 15, 1893), with the two cylinders on each side, placed one above the other; the system of the Brooks Locomotive Works, with the cylinders placed tandem; and the Johnstone system (Mexican Central Railway, Eng. News, Jan. 5, 1893), with concentric cylinders.

THE ENGINEERS' PLANS FOR A NEW YORK RAPID TRANSIT RAILWAY.

If we measure by the standard of dollars involved, the New York Rapid Transit Railway will take rank with the greatest engineering enterprises of the world. It is excelled, in fact, only by such great works as the Suez, Manchester and Baltic ship canals, or by the projected canals to connect the Atlantic and Pacific, or by that proposed to connect the Hudson River with the Great Lakes. From the economic point of view the enterprise is also of the greatest interest, for it is to be constructed on a unique plan, combining municipal control and ownership with the economies secured by construction and operation by a private corporation. Finally, from an engineering point of view the problems involved are of the greatest interest; for while the separate elements of the design have each precedents in previous works, their combination in a work of such magnitude is something entirely new.

In view of these facts, we have kept our readers fully informed of the progress of the enterprise from its inception, and shall continue to do so, with such comment as may seem needful.

To briefly sum up the recent history of the enterprise: Following the approval of the enterprise by popular vote in the November election, the Commission instructed its Chief Engineer, Mr. W. B. Parsons, to report what changes, if any, were desirable in the plans adopted by the former Commission and provisionally adopted by this Commission, together with an estimate of cost. Mr. Parsons' report, approved by Messrs. Theodore Cooper and Alphonse Fteley, as Consulting Engineers, was published in our issue of Dec. 27. The Commission appointed a Board of Experts to consider these recommendations of its Chief Engineer and incidentally to consider generally the rapid transit problem; and the report of that Board was published in our last issue. It is our purpose in the present article to discuss the principal recommendations of these two reports.

Size of Car and Cross-Section of Tunnel.—Among Mr. Parsons' most important recommendations was that the standard car of the Manhattan Elevated should be adopted, instead of the smaller car proposed in the plans adopted by the former Commission. This smaller car had a body of 8 ft. in width and 8 ft. 6 ins. in height from floor to ceiling. The Manhattan Elevated car will require an increase of 1½ ft. in the depth of the tunnel cross-section (making it 13 ft. high) and an increase of 6 ft. in the width of the standard four-track tunnel is proposed, making it 50 ft., instead of 44 ft.

The importance of this question arises from the fact that an increase in height and width of the tunnel means a very considerable increase in its cost. This is especially true of any increase in height, which increases the depth of excavation and the consequent difficulties with ground water. Notwithstanding this fact, careful study seems to show that the recommendation that the size of the car body should be increased was a wise one. You cannot pack a number of human beings in a closed chamber and keep them comfortable without having not only a certain influx of fresh air, but a certain volume of air per person. Mr. E. Moody Boynton, in urging the claims of his "bicycle railway" before the Massachusetts legislature last winter, laid great stress on the fact that his cars carried a far larger number of passengers per 100 sq. ft. of floor space than any cars in use on elevated or surface roads, as no room was taken up by aisles. The fallacy of this argument did not appear to be at all appreciated by those to whom it was addressed.

As a matter of fact, the engineer who proposes to design cars for use in this country should remember that Americans have been accustomed, by generations of experience with American railway cars, with Pullman and Wagner cars, and lately with the modern large size electric cars, to a good air space in their railway cars; and it would certainly be a mistake to imitate in a great city transit line the narrow and low-roofed cars of the City & South London Ry. New Yorkers have now become well accustomed to the Manhattan Elevated cars, and certainly any cars with less air space and consequent poorer ventilation would not meet with public favor. On the other hand, as has been before said in these columns, it would be folly to design the tunnel to take the largest size passenger or Pullman cars. Mr. Parsons has apparently hit the golden mean in recommending the Manhattan Elevated cars as the standard.

But while the increase in the size of the car body, thus giving a larger air space per passenger, is to be commended, it is by no means clear that the height of 13 ft., proposed for the tunnel, is not ex-

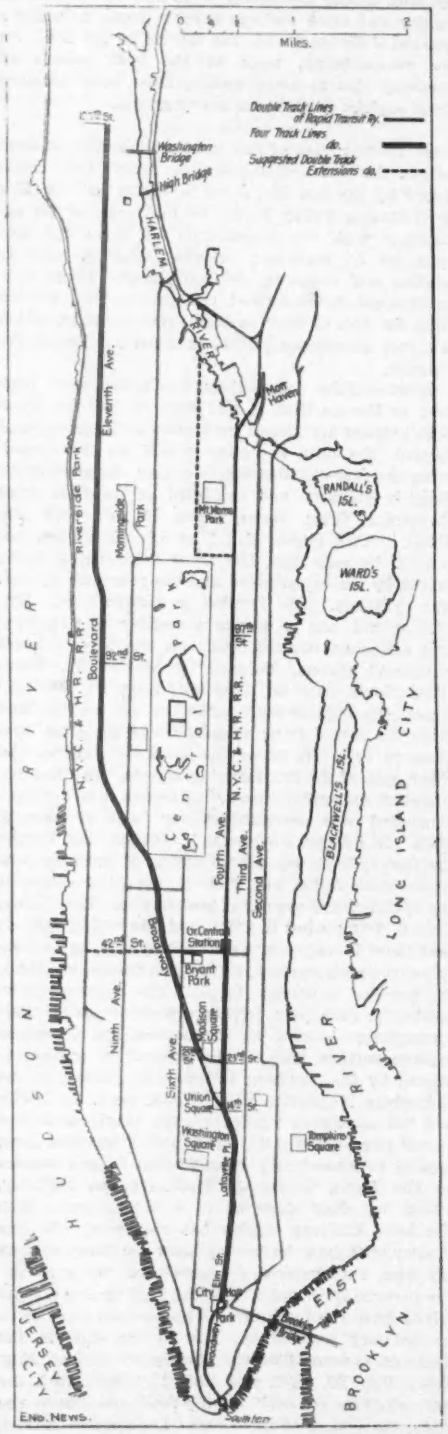
cessive by 6 ins. to 1 ft., or possibly more. The Manhattan cars are designed without any attempt to place the bodies low on the trucks; on the contrary, the car floor is purposely placed high above the rail level, to make access to the track surface from the station platforms difficult. In designing a car for tunnel service it would be worse than useless to perch a car body at such a height on its trucks. Probably no engineer familiar with railway car design will question the possibility of placing a car body of the Manhattan dimensions considerably lower on the trucks; but we do not even need to rely on possibilities of design, for there are hundreds of electric cars now in daily service in this country running at speeds which at times reach 30 to 40 miles per hour, which have the car floor not more than 2 ft. to 2 ft. 6 ins. above the rail. As an example of what is is possible to do in economizing space, we may mention that on the new underground electric railway in Budapest cars are to be used with a height from floor to ceiling of about 7 ft. 6 ins., and are to run in a tunnel 8 ft. 8 ins. in height, from top of rail to bottom of roof beam. Of course, it would not be well to go to any such extreme in building a road of the character of the New York Rapid Transit Ry. On the other hand, a car set low on its trucks has its center of gravity lowered, and rides better around curves. Any increase of height in the tunnel beyond what is necessary to give reasonable clearance adds nothing whatever in the way of safety and increases enormously the cost of construction. For these reasons it is to be hoped that the action by which the height of the tunnel is fixed at 13 ft. may be reconsidered.

The recommendation that the width of the tunnel should be increased, however, stands on unimpregnable ground. We must expect a certain proportion of derailments on this as on every other railway, and while serious consequences can be pretty certainly averted by the use of guard rails, the clearance between tracks should be sufficient to permit considerable swerving of a derailed car without fouling the adjacent track. As for any proposal to lessen the width of the tunnel by using narrower cars, it must be remembered that the width of the cars is a most important unit in limiting the capacity of the road and the rate of movement of trains. In the rush hours, the width of the cars will determine their passenger capacity per foot of train length; and it is better (within reasonable limits) to handle heavy traffic with wide cars than with narrow cars, which necessitate long trains and long station platforms, on which it is difficult to distribute equally the passengers.

Building the Road in Open Cut.—The recommendation, in which all the engineers agree, to build substantially all the road in open cut rather than in tunnel, can best be characterized as sound commonsense. There are forty contractors accustomed to open-cut work in city streets,and ready to make close figures for such work, where there is one who would be willing to attempt tunnelling close to the surface of a busy street. The latest and largest piece of work, in soft ground tunnelling under a city street in this country, the Baltimore Belt Ry., is an excellent example of how not to build such a piece of work as the New York Rapid Transit Ry. There have been numerous proposals to use hydraulic shields, so as to execute the work without disturbing the pipes or obstructing the streets; but such experience as has been had with such shields in running sand does not encourage their adoption here.

The obstruction of the street by building the road in open cut will be not a whit greater than is being constantly experienced in the laying of sewers, water and gas mains, cable railway lines, and electric subways. Further, the construction can be greatly facilitated and cheapened by the use of trench machines, of which several excellent patterns are now on the market and have well proved their value. These machines will not only save an enormous expense in handling material, but they will in great measure obviate the necessity of carting the excavated dirt through the streets, and of heaping it beside the trenches, thus greatly decreasing the obstructions to street traffic by the work.

A point, which is mentioned in neither of the published reports, but which must soon receive attention, is the disposition of the pipes in the city streets. As will be remembered, in the Worthen plan, adopted by the old Commission, it was proposed to use a shield in construction, and to leave the pipes undisturbed. But, if the road is to be built in open cut, all the pipes must be dug up. It would be a great pity to bury them in the earth again, and it would certainly add little to the cost of the work to collect the pipes above the tunnel roof in a simple brick subway, accessible from manholes at the street corners. As has been often pointed out in these columns, the owners of these pipe lines, who are



saved the cost of digging them up for repairs and renewals, and the city, which is saved the destruction of its pavement foundations which this constant tearing up entails, could well afford to pay the extra cost of building such a subway rather than have the pipes again buried in the earth. Thus the construction of such a subway need add nothing to the cost of building the railway. The rapid transit law provides that "the said board may in its discretion include in such plans provisions for subways or tunnels for sewer, gas or water pipes, electric wires and other conductors proper to be placed underground, whenever necessary so to do, in order to permit of the proper construction of any railway herein provided for, in accordance with the plans and specifications of the said board."

It may be argued that a systematic disposition of these underground pipes is not a necessity to the "proper" construction of the road; but, on the other hand, every engineer will admit that the task of keeping the tunnel dry and well ventilated will be much more easy and certain of successful accomplishment if the water and gas pipes above its roof are in an open, drained and ventilated chamber, where they are accessible for inspection, than if they are simply buried in the dirt overhead.

Route Proposed.—The accompanying map shows the lines proposed by the Board of Experts, the total extent of which is 19 miles. The most important change from the old Commission's plans was the location of the line between City Hall Park and 14th St. on Elm St., instead of on Broadway. Our readers will recall that Elm St. is to be practically entirely reconstructed, and hence the rapid transit railway could be built beneath it at very small cost. The collateral advantages arising from the abandonment of this section of Broadway we pointed out last week.

Unfortunately, there are legal difficulties which are likely to delay the opening of Elm St. for two years or more. It is somewhat doubtful also, we believe, whether such a great change could be legally made in the provisionally adopted route on which the popular vote was taken. In view of these facts, the Commission has been advised by its counsel not to change the route to Elm St., as recommended by the engineers. It may be now taken as practically settled, therefore, that Broadway will be the route adopted from South Ferry to 14th St. Above 14th St., the four-track line up Broadway, the Boulevard and 11th Ave. to 185th St., seems to be a certainty, and the same may be said of the East side line to the Grand Street Station. The extensions on the West side to Kingsbridge and the city limits, and on the East side to Mott Haven and thence to various parts of the "Annexed District," will probably be postponed for the present until it is found how great an expenditure is required for the other lines.

Increasing the Capacity of the Manhattan Elevated R. R.—The feature of the Board of Experts' report, which attracted most general public comment, was its recommendation that the Commission should require the Manhattan Elevated Co. to build additional tracks and run express trains upon them.

At its meeting, on Feb. 5, the Commission put a definite veto on this proposition, on the ground that the law required the municipal construction of a new system of rapid transit, and the Commission has no right to turn aside to strengthen a competitor to such a system. From an engineering point of view, moreover, it is not entirely clear that any important gain in the time of securing rapid transit could be made by the proposed arrangement with the Manhattan Ry. It is to be remembered that the comparison is not between the time required to build an elevated structure and that necessary to drive tunnels under Broadway. On the contrary, the comparison is between the time necessary to practically rebuild a good part of the Manhattan Elevated lines without interrupting the present heavy traffic upon them and the time required to build the rapid transit railway as now planned, practically all in open cut. There is nothing experimental or doubtful in building a subway beneath a city street and laying the necessary tracks in it. Similar work is being carried on by contractors all the time. As the city's credit is ample and there is no need of distributing the expenditure over a series of years, the work can be attacked at a large number of points simultaneously. If it were proposed to experiment with tunnelling schemes, especially in the soft ground section of Broadway from 34th St. south, the case would be entirely different. It has taken four years, for example, to complete the Howard St. tunnel, in Baltimore, 8,000 ft. in length. But with the road built in open cut with trench machines, the work can be carried on as rapidly as the building of a large sewer in a similar location.

To rebuild and strengthen the Manhattan structures to carry a third track could be done in a comparatively brief time, if traffic were abandoned;

but to carry on such an extensive rebuilding and strengthening as would be necessary to carry out the Board of Experts' recommendation, and still handle the daily traffic, would be a task which would extend over years.

General Plan of Construction and Estimates of Cost.—Concerning the general plan of construction recommended by the Chief Engineer and the estimates of cost submitted by him, extended criticism can hardly be made in the absence of full details. In general, however, the estimates appear to be very generous. As stated by Mr. Parsons in his report, a very large amount has been allowed by him for "contingencies," and this allowance it would be entirely proper to make if it were proposed to attempt to build the line without disturbing the street surface. If the line is built in open cut, however, there is no apparent reason "why any large allowance for contingencies should be made, or why a contractor should not be able to figure as closely on prices per cubic yard, as in any ordinary sewer contract. As shown in the table in last week's issue, the estimated cost of the road is considerably above $2,000,000 per mile, or over $1,000 per lin. yd. It would be possible, of course, to design a form of subway, and to load the contractor with such onerous restrictions that it would cost fully this amount to construct. On the other hand, it ought to be possible, at present prices of labor and material, to build a four-track road on the general lines already laid down for materially less money. More detailed discussion of the various plans of construction proposed we postpone to a future issue.

THE LOSS OF THE "ELBE."

Ocean travel has been remarkably free from serious disasters for the past two or three years, but one of the most terrible marine disasters that has ever been recorded occurred last week, when the fine steamship "Elbe," of the North German Lloyd Line, on her way from Bremen to New York, was run into on Jan. 30 and sank almost immediately. The steamer had sailed from Bremen the previous day and was in the North Sea, off the southeast coast of England, when it was struck by the bow of another steamer, the "Crathie" (a smaller vessel and presumably a tramp steamer), the blow being struck almost squarely on the vulnerable part of the side at the engine and boiler room compartments, a little aft of amidships, and an immense gap being cut in the hull. In a very short time, estimated at from 10 to 20 minuter, the latter being the time reported as given by the third officer, the steamer sank, with practically all on board. Only two boats were got out, and one of these was lost, so that only 22 persons, of about 350 persons on board (including 16 of the officers and crew), were saved. The accident occurred about 6 o'clock on a very dark and cold morning, when all the passengers were in bed, and probably a large proportion of the passengers never reached the deck. The "Crathie" had her bow stove in, but was not, apparently, in much danger, yet nevertheless her officers sailed away immediately for a Dutch port, without waiting to see if any assistance could be rendered to the people on the "Elbe," an action which puts a blot on the pages of marine records. This disaster, and the terrible loss of life due to the sudden sinking of the ship, once more call attention to the questions of the provisions made for safety in the event of collisions and other accidents at sea, and especially to the question of the efficiency of bulkheads and watertight compartments.

The short time available for making use of the means of safety and escape points to the need of some improved and prompt method of clearing and lowering the boats in emergency, and points also to the great superiority of life rafts to boats in such an emergency, as they cannot be easily capsized or stove in, or swamped, as boats often are, in being hastily launched from a ship in a heavy sea. With plenty of time and in a moderate sea, which conditions not unfrequently occur in marine disasters (as in case of fire or collision) boats are decidedly preferable, as provisions and light baggage can be stowed, they are more easily handled and steered, and the passengers and crew are more comfortable. But when it comes to the sudden sinking of a crowded ship, and the principal thing is to get hold of anything that will float, then the life raft has immense advantages over the boats. Nearly every steamer carries such rafts, consisting usually of a pair of horizontal metal cylinders with a platform between them, but in many cases they are stowed and lashed high up on skid beams or deck houses, where they are not so conspicuous as the boats and are less easily got at, while the number is almost invariably very much less than that of the boats. Various plans have been devised for utilizing the long deck seats and other fittings as rafts, but although few of these have been brought into practical use, it would seem most desirable that some means should be taken to increase the number and availability of rafts of some kind. They do not require to be carefully lowered by tackle (the ropes of which may be jammed or frozen fast in the blocks, as on the "Elbe"), but may be simply hove overboard and held alongside by a rope. Collapsible boats are valuable adjuncts where there is plenty of time to make arrangements for leaving the ship, but in the suddenness of such a disaster as that of last week, with the consequent excitement and frantic efforts for safety, these boats are absolutely useless. The "Elbe" is said to have had ten standing boats with air tanks, five or six collapsible boats and three or four patent life rafts, the boats being able to carry 30 to 50 persons, if carefully launched.

The safety of ocean travel has been greatly increased by the adoption of an international code of rules for ships meeting and passing each other, by the adoption of ocean routes for the leading transatlantic lines, and by laws respecting the construction and equipment of steamships. The loss of the "Elbe" seems to have been due to willful violation of the code and to lack of effectiveness of the provisions required by law and the principles of construction.

One of the most important questions is that respecting the bulkheads and watertight compartments. This plan of construction, intended to subdivide the hull so so as to prevent a general flooding, has often been claimed and assumed to afford almost absolute safety; but while the advantages and efficiency of the bulkheads have many times been proved, yet, on the other hand, many ships have gone down in spite of these safeguards. In the lower classes of cheaply-built tramp steamers it may happen that the bulkheads are not sufficiently strong or sufficiently braced to withstand the enormous pressure of a moving mass of water on one side, but in a first-class passenger steamer it may be assumed that ample provision is made for the strength of the bulkheads. Then comes the question of doors in the bulkheads, and it may be said at once that where such doors are provided they are a great and constant source of danger, no matter what provisions may be made for closing the doors automatically, or from the deck. Doors which are frequently used may be left open (in spite of all orders), or propped open if provided with automatic closing apparatus, and the operation of any apparatus from the deck is most likely to be overlooked in the wild excitement existing on board a ship rapidly sinking in the darkness. Besides this, the guides, catches, etc., readily become clogged and inoperative by rust, corrosion, dirt and neglect. Where the bulkheads are carried up solid to the main deck, there is, of course, some inconvenience in passing from one compartment to the other, especially on the large passenger steamers, with staterooms on three decks, involving much ascending and descending of stairs in passing from staterooms to dining saloon, etc., but this inconvenience is overwhelmingly overbalanced by the additional safety assured when it is most needed, without requiring any manual act or operation.

As to the size of the compartments, that is a matter to be considered in the design of the ship, except that at the engine and boiler room the subdivision is limited by the necessity of providing for the necessary open space, and these compartments are, therefore, the most vulnerable part of the hull, owing to their size and to the fact that the sides are nearly flat and inadequately braced. In the case of the "Elbe" the hull seems to have been struck close to the bulkhead between the engine and boiler rooms, so that the water had access to both these large compartments. Two methods of securing safety at these parts are apparent. The first is to provide horizontal bracing along the sides and across the hull: the former may be by means of horizontal girders, built in along the interior of the shell at the deck levels, and perhaps utilized as engineroom gangways; and the latter, by means of diagonal or circular bracing to receive and distribute the impact, and so arranged as to leave the necessary open spaces for the cylinders, etc. The ordinary transverse deck beams are, of course, practically useless, especially if the side of the ship is struck diagonally. The second method is to carry up a second skin or shell inside the compartment and to fill in the space between the skin plating with cellulose or other obturating material, which will swell when wet and fill the gap made in the side. The practical advantages of this material have been proved in service, and the material is not liable to decay or deterioraton, as pointed out in a paper read before the Society of Naval Architects and Marine Engineers in November, 1894 (Eng. News, Nov. 22, 1894). Of course, either method would add somewhat to the cost of construction and, perhaps, introduce certain inconveniences, but such cost or inconvenience is not to be considered in comparison with the immense loss in money and reputation, and the bad moral effect upon travellers, consequent upon such a disaster as the sinking of the "Elbe."

Another point of importance to both the colliding vessels is that of the shape of the stem or bow. Sailing ships, whether of wood or iron, have always had bows curving outwards from the end of the keel or a point below the waterline, so that the end above water projects several feet beyond the stem at the waterline, and this form of construction has been followed in a limited number of steamers. The advantage to the vessel that is struck is that the blow is received above the waterline and a great part of the force of the collision must be absorbed in the crushing of the upper part of the hull of one vessel and the bow of the other, before the stem of the striking steamer cuts down to the waterline. The advantage to the vessel that is struck is that her own damage may very probably be limited to the part of the bow that is above water, the bow not being stove in so as to let water into the forward compartment. One objection to this is the increased space for docking, which, however, should not be considered as of paramount importance, but as a matter of fact nearly all modern steamers are built with the straight and deadly "steamer" stem, which cuts right into the opposing hull down to the waterline at the first blow.

It is matter of thankfulness that the enormous amount of ocean travel is carried on so safely and with so comparatively few accidents, ocean liners being run with almost as much regularity as railway trains, and, of course, absolute safety can never be attained, but the occurrence of such disasters offers matter for careful consideration by shipbuilders and shipowners, who should be prompt to take advantage of the lessons thus forcibly taught.

LETTERS TO THE EDITOR.

A CONTRACTOR'S OPINION OF THE JERSEY CITY WATER SPECIFICATIONS.

Sir: The reform government of Jersey City, which came into power last May, has been struggling with the question of a new water supply, and after several attempts to get a scheme into presentable shape, has recently published very voluminous specifications, "not," as they say, "for the purpose of obtaining proposals thereunder," but "to afford opportunity for the fullest criticism," an opportunity which it seems to me is a very open one, and easily availed of.

When a large city desires any great work, it is customary first to determine for itself what is wanted, and the method of obtaining it, and then to invite contractors to perform the work.

The specifications advertised by Jersey City appears to be a confession that the city is uncertain as to what it wants, and distrustful of its own resources for obtaining a new water supply. Its officials, therefore, very properly call upon such persons as have the necessary knowledge and means to provide for them what they cannot provide for themselves. But, having issued an invitation for that purpose, they proceed to close the door to any acceptance of the invitation, and to bar it by conditions impossible to be complied with. The city proposes not to invest any money, nor to issue any bonds, nor to afford any financial aid in

any way to the contractor. It will have no substantial or pecuniary interest in the venture, and will occupy a position involving no hazard to itself. It invites a power greater than itself to come to its aid, and then demands a pledge of $1,000,000 as a guaranty for performing the work in the only way to make it a paying investment. Such a bond is unreasonable towards the contractor, and impolitic for the city, because it necessarily increases the price to be paid.

The bond of $500,000, for a period of 25 years, will probably prove to be impossible, but an equivalent might be found in the retention of a portion of the payments by the city.

The specifications do not contain a guaranty by the city of the right of eminent domain, but propose to "place at the disposal of the contractor such powers as it now has, or may hereafter acquire, to enable him to acquire by condemnation the necessary land." The contractor must, therefore, search the laws to ascertain what rights of condemnation the city now has, and will discover, perhaps, that such rights are insufficient for his purpose. He cannot safely proceed until such right is guaranteed by the city.

A fixed standard of purity, such as the specifications require, is impossible to be applied to the water of large streams from which a daily flow of many million gallons is obtained. The Jersey City "News" discusses this feature of the specifications intelligently. It says:

> It substitutes the theory of the chemist's laboratory for the facts of nature. . . . All that we can demand from contractors is that they give us the product of the northern watershed of the state in its native condition. . . . When we say that it shall not exhibit more than a certain percentage of this or that foreign matter, we undertake to dictate that the leaves shall not blow into the streams in the autumn, and that the spring freshets shall not wash down earth and sand.

The penalty imposed upon the contractor for failing to subvert the laws of nature is to be, as provided by the specifications, a suspension of payments for the use of the water until the city is satisfied as to its purity. There are other embarrassing features and conditions of the specifications which will preclude bidders, but I have called attention to a few of the most salient objections which are sufficient to prevent contractors and financiers from undertaking the proposed work.

If Jersey City desires to make available the knowledge of others as to sources of supply and methods of obtaining it; if the city, in the absence of any financial resources of its own, desires to command the capital of others for construction of water-works; if it intends to invoke a genuine competition, which will secure the benefit of the lowest price for such works, then there appears to be but one course to pursue. Let the city officers name only those conditions which are essential, such as the required quantity of water, present and future, and the reserves in reservoirs and watersheds; the sources of supply which will be accepted only on condition that the quality of water shall be found on examination to be satisfactory; the price at which it can be furnished in the quantity required from time to time, with the option of purchase by the city. Then let contractors be invited to make their own propositions in their own way, including such guarantees for the protection of the city as they can afford, accompanied with a deposit of $100,000, in order to preclude sham propositions. The city will reserve the right to reject all propositions, and, in any event, will have suffered no injury, but will have made immense progress in exploring what now seems to be a "terra (et aqua) incognita."

It is not unlikely, however, that this course will lead to a complete solution of this vexed problem, which otherwise will continue to be a dark riddle.

Contractor.

New York, Feb. 5, 1895.

(For combined rigidity and impracticability the specifications criticised so vigorously above, and also in our last issue, surpass any which we now recall. We believe that the Board of Street and Water Commissioners intended to invite the widest possible competition; but in their zeal to protect the financial and sanitary interests of the people, and to avoid the imputations of complicity with contractors alleged against previous administrations, they have completely defeated their purpose, for no sane contractor could be expected to put in a bona fide bid under the conditions laid down, and could not comply with them if he did.

To require a bond for $1,000,000 during construction, and of half this sum for the long period of 25 years after completion, with the further provision that no payment would be made by the city for any and all water falling below an elaborate and arbitrary chemical standard, excludes all possible bidders, unless it were some one interest with unlimited means, holding the key to the situation, and calculating on being able to control the authorities during the execution of the contract. All modes of water purification thus far put in practical operation are excluded from the competition, as explained last week, although on their face the specifications invite bids for purifying the present Passaic River supply. The same standard of purity applies to bids for new supplies under either of the three proposed plans, and the contractor who agreed to comply with it would run great risks, to say the least.

A writer in the Jersey City "Democrat" points out that of the two possible supplies by pumping, one, the Hackensack, is shut out by the provision that prohibits the contractor from supplying water to any other city, while for the other supply, the Passaic, at Little Falls, the 60-days' storage required is not needed. It has also been urged that any available gravity supply capable of delivering into the present low-service reservoirs could be delivered into the high-service reservoirs without the pumping called for in one of the plans.

The long and short of the whole matter is that the specifications appear to have been prepared with out proper engineering or other advice. Before going further, the city would do well to employ a competent engineer to examine and report on all possible supplies and draw up specifications corresponding with natural conditions. Or, if the city desires to avail itself of the studies of others, as suggested by the specifications and by our correspondent, let it draw up the briefest possible request for detailed proposals from all possible bidders, and submit the bids and plans received to an able engineer or board of engineers for careful study, before making an award.—Ed.)

THE CRACKS IN THE RESERVOIR AT PORTLAND, ORE.

Sir: I have received your letter of Jan. 10 in relation to the cracks in our new reservoir, No. 3.

The side slopes of the reservoir are on a grade of 1½ to 1, and are covered with a lining of 6 ins. of concrete made up with twisted iron rods and anchored at intervals of 10 ft., with iron rods surrounded by concrete. Back of the concrete there are tile drains which take off the water through a pipe passing under the concrete lining of the bottom of the reservoir. Above the dam for a distance of 300 ft. on the west side of the reservoir the concrete lining has cracked in places along a horizontal line about 3 ft. above the bottom. There is also a vertical crack in the lining at one or two places. The dam and the lining on the east and north sides are tight. The reservoir is in a ravine and the sides and bottom are of a tough blue clay, and some apprehension was felt that the crack was due to the pressure of the material from the hill sliding over the clay. But the reservoir was excavated last year and stood without motion all the winter before being lined with concrete, and the slopes have not changed or moved during the rains and snows of the past three weeks.

I think that the trouble is due to springs back of the clay on which the lining is laid, and am running two tunnels back from the bottom of the reservoir for the purpose of drainage. In the mean time the water is supplied to the city through the gate house of the reservoir and there has been no interruption to the supply.

Yours truly, Isaac W. Smith.
Chief Engineer Water Committee.

Portland, Ore., Jan. 17, 1895.

(A brief description of the four reservoirs connected with the new water supply for Portland, of which this is one, was given in our issue of Nov. 15, 1894.—Ed.)

INTERPRETING SPECIFICATIONS FOR PROPORTIONING CONCRETE BY VOLUME.

Sir: I would like very much to have you construe the following wording in specifications for concrete: "All concrete is to be composed of one part Portland cement, two parts sand, four part gravel, all by measure." I have recently seen letters form prominent engineers, both East and West, on this point, and I see that there are two constructions being placed upon the above wording.

Case 1.—One commercial barrel of cement, packed as delivered upon the works, the capacity of this same barrel to be used as a unit of measurement for the sand and gravel measured loose.

Case 2.—Cement, sand and gravel to be measured alike, loose, in any vessel to be selected.

To make myself plain, let the capacity of a cement barrel equal 3.33 cu. ft., then the cement packed in the barrel, as delivered, will equal 3.33 cu. ft.; then our proportions would be as follows:

	Cu. ft.
Case 1.—1 cement, 1 bbl. packed as delivered	3.33
2 sand, measured loose	6.66
4 gravel, " "	13.32
Total	23.31

	Cu. ft.
Case 2.—1 cement, 1 bbl. packed as delivered, but measuring and making loose	4
2 sand, measured loose	8
4 gravel, " "	16
Total	28

Here is a difference under the same specifications, with the same barrel of cement of 4.69 cu. ft. (not taking into consideration the question of voids filled by the sand and cement). As will be seen in a large work, the question of dollars and cents would be an important one; but if the specifications were drawn with a view to applying case 1, and in actual practice case 2 was applied, and if the proportions were such that under case 1 there would be only sufficient cement to properly cement the mass together; then under case 2 the concrete, when made, would be lacking in cementing material, thus becoming a more important question than the dollars and cents involved. I know in actual work both cases are being used, and it seems to me that it is a very important point to be decided definitely, one way or the other, or else this very common form of wording of specifications for concrete should be changed.

Very respectfully, R. C. Hollyday,
Civil Engineer, U. S. N.

Puget Sound Naval Station, Port Orchard, Washington, Jan. 25, 1895.

(Our correspondent asks an interesting question and one that certainly should be considered in framing exact specifications for proportioning concrete. The more common practice is to dump the packed barrel of cement on the mixing floor and use the cement barrel itself as a unit for measuring the sand and gravel. And this seems to be the correct method; so far as the total cubic mass obtained from "a barrel" of cement is concerned. The sand and gravel are not compressible, and are practically "packed" when put into the measure, and safe practice would appear to demand that the cement be packed also. The proportions of cement to the total mass, not considering voids, are identical in both the cases referred to, or 1 to 7. But in the one case the contractor obtains 4.7 cu. ft. more concrete from the "barrel of cement" than in the other. For this reason it is important to clearly state in the specifications just what the engineer means in this connection, both to avoid controversy on the question of dollars involved, and to be assured that he has the quality of concrete demanded. As to the words "by measure" in the specifications it would be probably held by the courts that a measure of cement was intended, and not a measure of cement and air combined.—Ed.)

THREE-CYLINDER SIMPLE LOCOMOTIVES; ERIE & WYOMING VALLEY R. R.

(With inset.)

While three-cylinder locomotives operated on the compound system have been extensively used (notably on the London & Northwestern Ry. of England), locomotives with three cylinders each taking live steam from the boiler are a decided innovation, and we illustrate and describe this week some three-cylinder mogul engines on this plan recently built for the Erie & Wyoming Valley R. R. in Pennsylvania by the Baldwin Locomotive Works. These engines were designed by the late John B. Smith, President of the Erie & Wyoming Valley R. R., and some of their principal features are covered by patents issued to him.

Concerning the origin of this design, Mr. Smith wrote us some months ago that in his long experience as Superintendent of the Pennsylvania Coal Co.'s gravity railway in Pennsylvania, where there were a number of inclined planes averaging 2,000 ft. in length, with a rise of 200 ft. (or a grade of 10%) he found that the winding engines used at these planes would haul a greater load if built with three cylinders than with two in the ordinary manner. The explanation for this is that the three cranks equally spaced gave a more even turning motion on the shaft and consequently a steadier pull upon the load. The winding engines hauled the load by means of endless wire ropes wound around friction drums, and the uneven turning motion would tend to make the rope slip on the drums. Mr. Smith therefore formed the opinion that in a similar manner locomotives with three cylinders of the same capacity as any two cylinders they might be designed to replace, would haul a heavier load.

Ten years ago the gravity railway referred to was changed to a steam railway worked by ordinary locomotives, and Mr. Smith decided to try the three cylinders, working on cranks 120° apart, on a

locomotive. He accordingly had three small locomotives, of about 12 tons each, built on this principle in 1881, and these worked to his entire satisfaction. In 1892 the railway adopted the same principle in a large passenger engine built at its shops at Dunmore, Pa, and has since built two consolidation engines on this principle at its shops, all of which have given satisfaction, and during the past year the Baldwin Locomotive Works have built the three mogul engines above referred to. It will be noted that the design is not intended to increase the actual capacity of the engine, but merely by means of a more uniform turning motion on the axles to give a more steady and continuous strain on the drawbars, thus reducing the tendency to slip the driving wheels, and reducing the breaking of car couplings of heavy coal trains on steep grades.

In the drawings on our inset sheet made from blueprints furnished us by the Baldwin Locomotive Works, Fig. 1 is an elevation, and Fig. 2 shows the cross-section. The cylinders all have an inclination of 4 ins. in 35 ins., and the inside cylinder is placed close against the right-hand frame, with the valve chest close beside that of the outside cylinder and right over the frame, as shown in Fig. 3, the frame being offset to allow the necessary space as shown in the small plan Fig. 4. The three cranks are set 120° apart. The crank axle is shown in Fig. 5. The engines have Wootten fireboxes for burning fine anthracite coal, and the tenders are of peculiar design, running on six wheels carried by heavy plate frames as in common English practice. The tenders have Vauclain wrought iron wheels with steel tires, and the engine trucks have Boles steel-tired wheels. The general dimensions of the engines are as follows:

Dimensions of Three-Cylinder Mogul Locomotives; Erie & Wyoming Valley R. R.

Running Gear—Driving wheels (six), diam.	4 ft. 9 ins.
Truck wheels (two), diam.	2 " 6 "
Tender wheels (six), diam.	3 " 6 "
Engine truck, length of radius bar	5 " 3½ "
Engine truck	Swing bolster
Journals, driving axles	8½ × 8½ ins.
" truck axles	5 × 10 "
" tender axles	6¼ × 10 "
Wheel base.—Driving	14 ft. 0 ins.
Total engine	21 " 7 "
" tender	11 " 6 "
" engine and tender	46 " 8½ "
Cent. of truck-pin to cent. of lead. driver	7 " 7 "
No. of wheels having blind tires	None (all flanged)
Weight in working order; on drivers	110,100 lbs.
On truck wheels	18,000 "
Engine, total	128,100 "
Tender, total	90,000 "
Engine and tender, loaded	218,100 "
Tender, empty	36,850 "
Of full coal capacity	19,918 "
Of full water capacity of tank	33,332 "
Cylinders (three)	17 × 24 ins.
Distance, center to center	7 ft. 2 ins.
" center to valve face	1 " 6⅞ "
Piston rod, diam.	3 "
Form of crosshead and guides	Laird type
Connecting rod, length between centers	7 ft. 9¼ ins.
Valve Gear.—Type	Allen balanced
Ports: length, 13½ ins.; width steam, 1⅝ ins.; width exhaust, 3 ins.	
Slide valves: lap, ⅞ in.; max. travel, 5¼ ins.; lead, 1-16 in.	
Boiler.—Type	Straight top
Diam. of barrel inside	5 ft. 3 ins.
Thickness of barrel plates	9-16 in.
" of smokebox tube plate	½ "
Height from rail to center line	8 ft. 10 ins.
Length of smokebox	3 " 3½ "
Working steam pressure	150 lbs.
Firebox.—Type	Wootten
Length inside	9 ft. 6 ins.
Width inside	8 " 0 "
Depth at front	4 " 4 "
" at back	4 " 1 "
Thickness of side and back plates	5-16 in.
" of crown sheet	⅜ "
" of tube sheet	½ "
Grate area	76 sq. ft.
Staybolts, diam., ⅞ in.; pitch	4 ins.
Water space, width	3½ "
Tubes.—Material, iron; number, 307; pitch	2½ "
Diam., inside....1.54 ins.; outside	1¾ ins.
Length between tube plates	9 ft. 10½ "
Total fire area of tube openings	4 sq. ft.
Heating Surface.—Tubes, exterior	1,388.7 "
Tubes, interior	1,222.30 "
Firebox	165.30 "
Combustion chamber	46.00 "
Total with exterior tube area	1,600.09 "
" with interior tube area	1,433.60 "
Miscellaneous.—Exhaust nozzle, diam.	2¾ ins.
Smokestack, smallest diam.	14⅞ "
" height from rail to top	14 ft. 11½ "
Capacity of tank	4,000 galls.
" of coal space	19,918 lbs.
Brake fittings	American, outside equalized

In October, 1894, some tests were made under the direction of the Baldwin Locomotive Works of one of the railway company's three-cylinder consolidation engines, No. 4, a Baldwin two-cylinder consolidation engine, No. 3, and a Baldwin three-cylinder mogul engine, No. 35. These tests showed the practical efficiency of the three-cylinder system, and also indicated that, with some changes in design, still better results should be obtained. The leading dimensions of the engines were as follows:

	2-cyl. Engine, No. 3.	3-cyl. Eng.ne. No. 4.	3-cyl. Engine, No. 35.
Driving wheels diam., ins.	49½	49¾	57
Wt. on driving wheels, lbs.	110,000	112,350	110,010
Wt. of engine and tender, lbs.	188,000	191,650	202,000
Size of cylinders, ins.	20 × 24	16½ × 24	17 × 24
Piston rods, diam., ins.	3	3	3
Steam ports, ins.	1¼ × 16	1⅜×12½	1⅜×13½
Exhaust ports, ins.	2½ × 16	2⅝×12½	3 × 13½
Valves, outside lap, ins.	⅞	¾	⅞
" inside lap, ins.	1-32	1-32	1-32
" lead at full stroke, ins.	1-16	1-16	1-16
" travel, ins.	5½	5¼	5¼
Boiler, diam., smallest ring, ins	61	60	64
Firebox, ft.	10 × 8	9½ × 8	9½ × 8
Tubes, number	211	230	307
" diam., ins.	2	2	1¾
" length	12′ 6¼″	11′ 2″	10′ 0″
Total heating surface, sq. ft.	1,731	1,734	1,600

The test was made between Avoca and West Junction, 10.2 miles, on a grade averaging 1%. Each engine hauled 20 loaded cars on all trips, the difference in weight of trains being unavoidable, and being such as will be met with in ordinary service. Indicator diagrams were taken simultaneously from all cylinders at the rate of 40 per hour. There was practically no difference in the conditions of rail and weather during the series of tests. The following table gives a comparison of the average results of the two consolidation engines for two trips:

	2-cyl. Engine No. 3. lbs.	3-cyl. Engine No. 4. lbs.	In favor of No. 4. per ct.
Water, total	19,843	20,436	(—2.9)
Coal, total	2,760	2,717	1.6
Water evap. per lb. of coal	7.18	7.52	4.5
Weight of train, incldg eng. and tender, lbs.	1,557,020	1,598,350	2.6
Train per lb. of coal	564.6	588.3	4.3
Train per lb. of water	78.5	78.2	..
Water used per hour	18,765	18,252	2.7
Water per HP. per hour	38.17	38.39	..

The next table shows the performance of the mogul and consolidation engines, reduced to the thermal unit basis. This method takes into account all the variations of service, such as high or low steam pressure, speed, and load, thus reducing the performance of each engine to a standard that is comparable, as credit is given for the energy expended in doing the work. It is, therefore, especially valuable in comparing engines of different classes, as in the present instance. The table also gives the average smokebox vacuum on all trips, showing the reduced force of the draft due to the more continuous exhaust of the three-cylinder engines:

	Consol. 2-cyl. Engine No. 3.	Consol. 3-cyl. Eng.ne No. 4.	Mogul 3-cyl. Engine No. 35.
Duration of test, hours	1.1166	1.1166	1.1666
Water used, total lbs.	20,654	20,927	21,417
Water used per hour, lbs.	18,497	18,741	18,637
Average HP. per hour	474.6	483	462.9
Av. st'm press., lbs., sq.in.	126	141	156
Total heat of steam at ave. pressure, thermal units	1,221.7	1,224.1	1,226.4
Temperature feed water, degrees Fahr.	58	56	54
Steam accounted for by indicator, lbs.	31.01	30.19	29.15
Steam used, accounted for by indicator, %	80	77.8	73.5
Loss due to condensation, leakage, etc., %	20	22.2	26.5
Water used per HP. per hour, actual, lbs.	38.76	38.8	39.68
No. of thermal units required to produce 1 HP. per hour	45,105	45,322	46,401.8
No. thermal units to produce total power	24,056,060	24,444,529	25,109,291
Weight, train, incldg eng. and tender, lbs.	1,350,300	1,623,190	1,319,960
No. thermal units required per lb. of train	15.52	15.06	19.02
P. c. of economy in total number of thermal units	....	2.96	....
Ave. smokebox vacuum, ins. of water	8.07	5.82	5.30
Highest smokebox vacuum, ins. of water	9.00	5.87	6.50
Lowest smokebox vacuum, ins. of water	7.75	3.75	4.00

The report points out that the use of three cylinders in conjunction with the crank axle makes it possible, by dividing the rotative impulses into sixths, instead of fourths, of a revolution, as in the case of a two-cylinder engine, to produce a more nearly continuous application of the power developed, the advantages of which are obvious. The diagram, Fig. 6, shows the combined rotative effects of the cranks of the two-cylinder and three-cylinder consolidation engines, and is constructed from indicator diagrams taken at a cut-off of 8 ins., or one-third the stroke. The two-cylinder engine does not show as great variation in rotative effect as would exist when doing lighter work at higher speed, but the difference between the two types is very marked, and shows decidedly in favor of the three-cylinder system. The principal effects of thus dividing the impulses are as follows: 1, to enable a greater proportion of the weight on the driving wheels to be utilized at higher rates of speed than in the two-cylinder engine; 2, to make it possible to considerably reduce the counterbalance weights necessary to balance the reciprocating parts. The three-cylinder mogul engine, No. 35, has the front and back driving wheels balanced for the revolving parts only, and the main wheels have no balance weights at all. The weight of the parallel rods carried by the main crank pin is said to be about sufficient to bring the three cranks in balance as shown in Fig. 7.

The report calls especial attention to the lighter draft of the three-cylinder locomotives, and argues that this lighter draft will result in an increased life of the boiler. Whether this be true or not, it is certain that if the lighter draft means that less steam is made by the boiler, the change would not be in the line of progress. The real advantage of the three-cylinder engine in this respect would appear to be in the fact that its draft would be more nearly a continuous pull on the fire, and not the sharp, tearing action of the ordinary locomotive when working at long cut-off, which is so detrimental to the action of the fire, and so wasteful of fuel, by blowing it out of the stack unconsumed.

The boiler and cylinder performances, as shown in the test reduced to a thermal unit basis, above recorded, give a clear idea of the difference between the three engines, and also indicate that improvements must be made in the design in order that the highest efficiency may be obtained. The results recorded in the comparative table show but little difference between the engines when the actual pounds of water used per indicated horsepower per hour are considered; but the pounds of water or steam accounted for by the indicator per horsepower per hour show a different state of affairs. The two-cylinder engine, No. 3, accounts for 80% of the total water used, which is normal, and to be expected. The three-cylinder engine No. 4, accounts for 77.8%, and three-cylinder engine No. 35, only 73.5%, engine No. 4 showing a loss of 2.2%, and engine No. 35 of 6.5%, when compared with the performance of engine No. 3. These losses, it is stated, cannot be looked for in the cylinder, as the piston and valves were tight, and only a slight proportion could be accounted for by the long steam-passages, so that the losses can only be explained by the fact that the steam supplied to the cylinders of each locomotive was of different quality, that from engine No. 35 having a large quantity of water entrained, and the others giving comparatively dry steam. The action of the indicator when on engine No. 35 gave continual evidence of the presence of entrained water; in fact, it was extremely difficult at times to take indicator diagrams that would not show the inconsistencies due to the presence of water, and this was especially the case with the middle cylinder. The engine steamed well, and an average of about three gages of water was carried from start to finish. Engine No. 4 showed but slight evidence of water, while engine No. 3 worked almost perfectly dry steam. This latter engine did not steam well, and on both tests there was but one gage of water in the boiler when the top of the hill was reached.

The amount of water carried over in steam depends mainly upon the following conditions: 1, The cubical contents of the steam space; 2, the area of the water from which the steam arises; 3, the distance from the top of the water to the opening of the throttle pipe; 4, the violence of ebullition. In engine No. 35, when carrying three gages of water, there is a space of only 7 ins. between the crown sheet and the shell, and in boilers hereafter made the dome should be as high as the clearances will admit, and the crown sheet dropped not less than 3 ins., which changes will insure a much better quality of steam, since they will affect favorably the four conditions stated above.

The indicator diagrams from engines No. 4 and No. 35 show a loss in steam pressure between the boiler and cylinders of from 13 to 20 lbs. per sq. in., which can only be accounted for by the combination of a small valve and indirect steam-pas-

sages. The back pressure in these engines was also higher than the slow speed would warrant. Engines No. 35 and No. 4 steamed sufficiently well to allow of enlarging the exhaust nozzles at least ¼ in. in diameter, and this would help the engines to some extent; but it is considered that careful designing of both steam and exhaust passages, especially for the middle cylinder, would almost wholly obviate this trouble. In the diagrams shown in Fig. 8, taken from engines No. 35 and No. 4, the middle cylinder of engine No. 35 consumes 30.31 lbs. of water per HP. per hour, and the outside cylinder only 27.55 lbs., an economy of over 9% in favor of the outside cylinder; and in engine No. 4 the difference ranges from 6% to 9% in favor of the outside cylinder. This increase in the water rate is caused by excessive cylinder clearance, and any move towards reducing these clearances by giving the admission port only the cubical capacity necessary to do the work, would result in a decreased water rate and a proportional decrease of fuel consumption.

Another point deduced from the information gathered, and one that perhaps has more bearing than any other on the successful operation of these engines, is that the engines are working at a very uneconomical point of cut-off; but to haul the trains up the hill, such cut-offs are necessary, and in consequence, the fuel account suffers. The most economical point of cut-off would be at about one-quarter stroke and from there to full stroke the economy gradually decreases. A shorter cut-off shows a more rapid decrease. This is plainly shown on Fig. 9, the diagrams being constructed from indicator diagrams taken from engines No. 35 and No. 4. The figures show the pounds of water used per indicated horsepower per hour at various points of cut-off. Engine No. 35, when cutting off at ⅞ stroke, indicates a water consumption of 33.04 lbs. per I. HP. per hour, and at one-third stroke 20.78 lbs., a difference of 12.26 lbs. per I. HP. per hour. When working at the average cut-off there is a difference of 7.24 lbs. per I. HP. per hour. Engine No. 4, between a cut-off of ⅞ and ⅓ stroke, shows a difference of 9.97 lbs., and at average work, 4.52 lbs. of water per I. HP. per hour. If Engine No. 35 could do the work at a cut-off of 8 ins., there would consequently be an apparent economy of 25.8% over the present rate of service, and engine No. 4, under the same conditions would show an economy of 12%. The report states that this economy can be obtained only by putting on larger cylinders, which would over-cylinder the engine at starting, but that this fault could be avoided by having the engineman start with a small throttle opening. An automatic sanding device would not only be economical in regard to sand, but would enable the engine to start better under adverse conditions. In making the cylinders larger the tractive power should be calculated by using the mean effective pressure at not more than half stroke. The following is given as the formula for the tractive power of these engines:

$$\frac{\frac{3 \times \text{M. E. P.}}{2} \times \text{stroke} \times (\text{diam. cyl.})^2}{\text{Diam. of driving wheels.}}$$

WATER PURIFICATION IN AMERICA.

The Crushed Tripoli Stone Filter at Carthage, Mo.

(Continued from Vol. XXXII., p. 453.)

A small filter crib was recently put in use by the Carthage (Mo.) Water-Works Co., in which the filtering material is crushed Tripoli stone. This stone is quarried at Seneca, Mo., by the American Tripoli Co., of Carthage, Mo. As used in the filter, it is in pieces ranging from the size of a walnut to that of a pea. According to an analysis made June 22, 1889, by Mr. W. H. Seaman, chemist, Missouri State School of Mines, Rolla, Mo., shows the following composition:

Silica ($Si O_2$)	98.100
Lime (Ca O)	0.184
Soda ($Na_2 O$)	0.230
Iron Oxide (Fe O and $Fe_2 O_3$)	0.270
Alumina ($Al_2 O_3$)	0.240
Water and loss on ignition	1.160
Organic matter	0.008
	100.192

The natural stone is soft, easily crushed to a fine powder, and is very absorbent. In a powdered form it is used as an abrasive and burnishing material, and in cut forms as Disc cylinders and tubes, for domestic and other water filters and for ink blotters in roller and tablet form.

The filter crib at Carthage is a very simple affair, 4 ft. wide, 8 ft. long, and 6 ft. high, the crushed stone being confined by boards or plank with ½-in. spaces between them. The water passes from the river directly through the crib. It is stated that good clarification has been obtained when the water was very muddy, and that as high as 1,000,000 gallons a day has been drawn through the crib. Obviously, at such a rate of filtration, the crib acts as a strainer, but in removing suspended matter the number of bacteria would be somewhat reduced. When the stone is so arranged that all water must pass through its pores, as in the filter cylinders and disks, the fineness of the grain indicates that a high percentage of the suspended matter, including bacteria, may be removed while the filter is clean. In beds of broken Tripoli stone the water would not only pass through the interstices of the material, but probably, to a considerable extent, through the pieces of stone themselves.

Mr. T. T. Luscombe, of the American Tripoli Co., has devised a filter for treating large quantities of water in which the filtration is upward and in which double or triple filtration is secured by conveying the water from the top of each filtering compartment to the bottom of the next by means of intermediate compartments or through pipes. A filter, 20 ft. long, 12 ft. wide, and 8 ft. high, filled with 6½ ft. of Tripoli stone, is suggested, divided into three longitudinal filtering compartments, the first wider than the other on account of receiving water in its worst state. Valves on the inlet and outlet of the filter, and drain pipes from each compartment, also controlled by a valve, or valves, would be provided for use in washing, which would be effected by directing the flow of water from the clear-water pipe to the drain pipe, thus reversing the flow through the filter, and bringing down the matter retained by the stone. It is proposed to mainly rely upon the water in the filter, at the time of shutting off the supply, for washing, but when found necessary to use additional washing it is provided for by a T-connection, placed in front of the discharge pipe valve, through which filtered water can be forced back from the main pipe to the top of the filter compartments. In this way a continuous reverse flow under pressure, taken at the top of the compartments, could be maintained until the material was cleansed. It is obvious that by building a battery of such filters any desired quantity of water could be treated.

ECONOMY IN LOCOMOTIVE FUEL ON RAILWAYS.

In our issue of Jan. 17 we gave nearly in full a valuable paper on the "Heat Value of Western Coals," read at the December meeting of the Western Railway Club, by Mr. Wm. Forsyth, M. Am. Soc. M. E., Mechanical Engineer of the Chicago, Burlington & Quincy R. R. At the January meeting of the club the consideration of the same subject of coal economy in locomotive practice was continued with a paper by Mr. S. P. Bush, Superintendent of Motive Power, Southwest System, Pennsylvania Co., and a very full discussion of both papers by the members of the club. An abstract of Mr. Bush's paper and the discussion following it is given herewith.

Calling attention to the necessity of determining the heat value of coal, as brought out by Mr. Forsyth, and to the work which has been done in improving the mechanical details of the engine, with the view of economizing fuel, Mr. Bush states that there is still another factor to be considered in economizing coal, and that is the efficiency of the men who handle the coal and operate the locomotive. Through the lack of careful attention and knowledge on the part of the engineers and firemen, fully 15% of the total coal consumed is wasted. From carefully kept records of the daily performance of over 1,000 enginemen, in the matter of fuel consumption, it has been found that the average performance is fully 15% below the performance of the best men, and in individual cases is as much as 40% below. The paper then continues:

The question is naturally asked how this saving can best be effected and the standard permanently raised. It may be briefly answered by saying, educating and disciplining and enlisting the hearty co-operation of the enginemen.

(1) It is necessary to keep accurate records of each man's work, which can be used as a constant check instead of something occasional.

(2) Establish fair standards of what should be done.

(3) Offer some inducement to the men for improving their work, something which will enlist their energies and ingenuity willingly rather than in a compulsory manner, for it must be admitted that volunteer work is much more effective than compulsory or hired work.

(4) Let every man see what he and his fellows are doing by posting in proper places monthly reports.

As to the first essential, it may seem impossible in some cases, but if the effort is earnestly made it will not be found even difficult. It is a simple matter to weigh or measure the amount of coal that is put on locomotive tenders. The amount left at the end of a run is also attainable by measurement if it is made level with the top of the coal space of the tank. A measuring strip secured to the side of coal space at half the height and running its entire length will be found convenient for this and quite as accurate as weighing.

As to the second essential, with proper records of the average requirements of the different classes of grades of work to be done, it is a simple matter to set the standards. These would be expressed as pounds of coal per car-mile, or ton-mile, after first deducting a quantity which an engine alone would require. This latter deduction is necessary on account of the necessity of having the standard or rate per car independent of the number of cars hauled. Different rates will of course have to be established as the work per car is greater or less.

As to the third essential, and by no means the least, there should be a thorough understanding among the men that their future with the company depends largely on their good performance and desire to improve. Again, it is perfectly right that those who rise above the standard, those who render better service, should receive better compensation, and this can be given in the way of some part of the saving they have effected, for instance, one-fourth to the engineer and one-fourth to the fireman, leaving one-half to the company.

For the fourth essential, it was stated that the records of the men should be made public. The influence that this exerts is considerable. It becomes a matter of much pride on the part of some of the men to see that success has attended their efforts, and that the knowledge of certain things which they have endeavored to attain results in such a way as to advance their relative standing. To many of those who have not done well it is a matter of much regret and leads to inquiry as to the cause, a sharpening of the wits and increased effort at improvement.

It is impossible to show here the influence that such a system can be made to exert, except to state the general result in the way of saving (which has already been put at 15%) to the railway company. The ways and means that the men find for effecting this are innumerable. Waste at the safety valve is stopped, steam is used expansively, there is more careful firing and less smoke; unnecessary movement or stoppage of trains is avoided, and many ingenious methods are resorted to that men will find and carry out only when prompted by voluntary impulses.

Discussion.

Mr. Lyon (C. G. W. Ry.).—Such a system as is spoken of in Mr. Bush's paper has been in effect on the Chicago Great Western Ry. for some months. Our trains are made up in the yards and handled by the despatchers on the actual tonnage basis, and not by loads and empties, so that we are enabled to obtain directly and very easily the ton-mileage of every train. We have very much the same system for arriving at the amount of coal used on each run, and we determine the coal used per ton-mile of total train on every trip. We also have established a coal rating or allowance on every division, for each direction and for every class of train. The coal performance sheets posted in the roundhouses show the number of tons of coal each engineer and each fireman have consumed during the month, the number of tons of coal they should have burned, according to our established rating, and the number of tons in excess of the allowance and the percentage of excess, and the men are given to understand that a continued poor record will not be tolerated. So far this plan has had a very marked effect on the handling of coal by the men. The rating or basis of consumption is from 0.7 to 1.2 tons of coal per 10,000 ton-miles of total train, or about 2.2 to 3.8 oz. per ton-mile, varying according to the class of train hauled.

Mr. G. W. Rhodes (C., B. & Q.).—We must bear in mind that if we are going to measure the enginemen by their performance, we must also be fair and reasonable in measuring what we give them. I will say frankly that I would not buy coal for my own consumption in the way that we measure the coal to the engineers, and I do not think there is anybody here who would buy coal in the loose way that it is generally put on engines I do not believe that is the case with Mr. Bush, because on the Pennsylvania they weigh the coal on the tank, and the engineer is judged by the coal on the tank and not by the coal the company buys.

Mr. Peck (C. & W. I. & Belt).—In answer to Mr. Forsyth's question, "Are we making any progress in economical coal burning?" I think we are. The figures he gives do not show how the work of the engine is increased. They show 18% increase in fuel, but probably the work of the engine shows in tons hauled about 40% increase, and the speed over 33⅓%. In 1883, when the records commenced, there were very few heavy trains, and 15 miles an hour was the speed. I was on the C., B. & Q. at that time and any man running faster than 15 miles an hour was laid off. Now they run 40 miles. The work has increased, not only on the C., B. & Q., but on all roads. When I first went to railroading there were strict orders that enginemen should not reverse their engines in switching; now they reverse them all day long and are discharged if they don't, yet they run as long as they did ten years ago. I think the performance of the engine increasing over 40% and the speed 33⅓% shows decidedly in favor of the engine.

Mr. D. L. Barnes.—Several tests made in England show that as you force an engine you will get less efficiency. Heavy trains are economical from an operating standpoint, but make the locomotive less economical as a steam engine. The question whether we are more economical in operating locomotives now than we used to be is perhaps impossible to settle, for the reason that we are now forcing locomotives so much more that if the apparatus was more economical the loss in forcing would more than make up the difference. These tests are an argument for big grates, because as the grate area increases so will the amount of coal burned per square foot per hour decrease, and as that decreases the economy decreases. That is rather an argument against deep fireboxes, as they cannot be made deep and have a large area of grate.

Mr. J. N. Barr.—I am inclined to think that in our endeavors to expand the grate surface we have decreased other dimensions and proportions that bear on the efficiency of the boiler. When we turn the engine out we figure that we are going to have 20% economy with the increased grate surface, but find when we measure up the coal that we have been burning a little more than we did before, and unless we take into consideration the shape of the firebox, the shape of the chamber in which the combustion is accomplished, I do not think we state the whole question. I think that the bald statement that the economy increases with the increase in the grate surface or the reduction of the pounds of coal per square foot burned, is an extremely misleading one, and one that has cost railroads a great deal of money in the past. I do not know that our ordinary stationary boilers to-day are much more economical with their low consumption of coal per square foot of grate surface than our locomotives. In fact, I have some figures which make me extremely skeptical on that subject, and I am inclined to think that you can very easily reach a point where consumption of fuel is too slow to maintain the body of fuel at the proper temperature to effect economical combustion. We are not erring that way in locomotives; but I believe that we err very frequently in stationary boilers, and that an increase in the pounds of coal burned per square foot on many of our stationary boilers would result in a very decided economy in coal consumption. Otherwise, I do not know how to account for the unconsumed fuel we know we carry through our present locomotive boilers.

Mr. C. M. Higginson (C., B. & Q.).—Mr. Peck said he thought the carload had increased about 40%. The increase is, in fact, about 10%. We have doubled the capacity of our car nominally, but we have in reality added 10% to the load. I think a vital mistake has been made in adopting large grates and small fire-boxes.

Mr. W. F. M. Goss.—I believe that railroads and other large consumers of coal have much to gain by the use of a standard furnace in which the quality of coal may be tested. Assuming that the coal to be tested is for use on locomotives, the testing plant should contain a locomotive boiler of medium size. Tests should be conducted while the boiler is making steam, but a pressure of 50 lbs. or less may be taken as a maximum. This will permit the boiler to be made of light material, and hence will keep down the first cost, and the limitation as to pressure will not in any way impair the value of the plant. There should be apparatus for securing data as follows: (a) Condition of coal, as to dryness. (b) Weight of coal fired. (c) Weight (or volume) of feed-water delivered to injectors. (d) Temperature of fuel. (e) Quality of steam generated. (f) Vacuum in smokebox. (g) Temperature in smokebox. (h) Composition of gases in smokebox. (i) Weight of dry ash. The observations are not numerous, and the accessory apparatus involved would be of the simplest sort. The first cost of a plant such as I have described, would not be great, neither would the cost of maintaining it be large. It goes without saying that results obtained by its use would have far greater practical value than those obtained by the use of a small coal calorimeter.

Mr. A. W. Gibbs (Pennsylvania R. R.).—I have had occasion to tabulate the results of a number of coal tests made with the same locomotives under similar conditions in which tests, in addition to the data usually taken, a chemical analysis and a calorimeter test were made of the coal used each day. It soon became evident that the results of the latter tests were often in open conflict with the actual results, so much in fact as to make it a question whether much reliance is to be placed upon laboratory tests of this kind. The chief criticism of the chemical test is that it is not sufficiently thorough, the composition of the volatile matter not being fixed. These constituents may be already partially oxidized, in which case the available heat value is reduced. The calorimeter as a means for determining the heat value is, I think, little more than a scientific toy, very interesting but very misleading, because the conditions governing the combustion in the calorimeter differ so widely from those of actual service. I think that the most that can be said for this test is that it gives an idea of the relative possible heat values. There appears to be room for improvement in this method regarded solely as a laboratory test, because the discrepancies in the results obtained by different instruments and men are too great.

As an instance of the conflicting results obtained by the calorimeter and from service, take one of the coals high in volatile matter. In the former the coal is burned in a submerged crucible, a stream of oxygen gas blowing down upon the coal, which burns only on top. As fast as the volatile part is set free it is completely burned, and finally the fixed carbon is also completely burned. Thus, if the manipulation is perfect, the different constituents of the coal should give up to the water their full heat value. This same coal in service is thrown upon a bed of hot fuel where it is first roasted, the volatile parts passing away largely unconsumed, while that part of the fixed carbon which is not carried away bodily by the force of the draft is more or less completely burned. The completeness depends on the depth of the bed, the force of the draft, the proper admission of air and the time given the gases to burn before they are cooled. Is it wonderful that with such different conditions the results are discordant?

In the case of high carbon coals which are often very friable, the method by which they are burned principally determines their heat value commercially; and a coal having a very high calorific value may give lower results than one having more ash, because the force of the draft is such as to carry away unburnt much of the more friable coal. I think that the only way of determining the commercial value of the coals is by testing them under conditions similar to those of the proposed service.

Mr. Wm. Forsyth (C., B. & Q.).—The discussion of my paper has brought up a number of facts relating to coal-burning on locomotives which must be some help toward the solution of the fuel problem on railroads.

The first part of the discussion seems to center in the controversy over wide and narrow fireboxes. I think it can be taken as a general statement which is very near the truth that the poorer the fuel the larger should be the grate. With the poor fuel used in the West, I do not believe that we have, with the ordinary boiler construction, reached a size of grate which is any too large. Where extra large fireboxes, like the Wootten, are used with bituminous coal, the size of the lump and the manner of firing have very much to do with success. With so large a grate, and with fuel of every size, from fine dirt up to lumps 6 or 8 ins. across, it is difficult to keep the grate covered, so that cold air is drawn through in large volumes, and more is lost in heating up this cold air than is gained by slow combustion. If coal is supplied in lumps of nearly uniform size, about like stove or egg coal, the Wootten firebox can be successfully used, but it is not suited to the irregular sizes of bituminous coal as ordinarily supplied to railroads. There is, however, a medium-sized grate which can be properly covered with coal, and properly fired, which is larger than the average grate now used on Western roads, and from which better results in coal economy can be obtained. I believe there has been a greater gain in the direction of economical coal-burning by the introduction of fireboxes 42 ins. wide and 8 to 10 ft. long than in any other one item in the mechanical construction of a locomotive. In regard to the relative value of tube-heating surface and firebox-heating surface, an experiment on our road seems to indicate that the firebox surface is so much more efficient that the tubes may be shortened and the firebox lengthened with economical results. While this might not be true for a perfectly clean boiler, it doubtless is the case with boilers as ordinarily found coated with scale and mud. The tubes get a very much thicker coating of scale and mud than the sheets of the firebox.

In the examination of a boiler which has been in service a year, using poor water, it will be found that the tubes have a coating of mud about ¼ in. thick, while that on the side sheets of the firebox is not 1-32 in. thick. The long tubes with such a coating cannot have much efficiency in conducting the heat of the gases to the water, while the firebox sheets, with much thinner coating, must conduct a much larger quantity of heat to the water in proportion to the relative heating surfaces. For these reasons I do not think that the relative value of tube-heating surface and firebox-heating surface can be definitely stated except as applied to clean boilers.

In regard to the best method of finding the relative value of coals, I agree with Prof. Goss and Mr. A. W. Gibbs, in recommending a small test boiler as preferable to the calorimeter, and the principal reason is that it deals with a much larger quantity of coal, and burns it under conditions more like those in which coal is generally used. The Pennsylvania Railway has been conducting coal tests in this way with a boiler in Philadelphia for several months past. As a laboratory instrument the calorimeter is useful because it gives indications of the relative heat values of coals which are nearly alike in composition, and because it is assumed that when a small sample is sent to the laboratory a report can only be made on the composition of the particular sample dealt with.

In regard to fuel accounts, it seems strange that the effort at reduced expenses has reached the largest item of expenses last. But there seems now to be a general awakening to the fact that it will pay to keep the fuel account of locomotives in such detail as will enable us to know how much saving we are making, and to handle the coal with definite measurements, so as to deal fairly with the enginemen, and then require of them, in return, a better service.

The coal premium system described in Mr. Bush's paper is doubtless the best way of handling the subject, and I expect to see it go into more general use on railroads, the same as piece-work is getting into general use in the shops. The principle in both cases is to pay the men in proportion to the amount of work done, and to the care and interest which they take in their work.

TESTS OF A LOCOMOTIVE USING OIL FUEL.

The question of the use of oil fuel for locomotives was discussed at some length in our issue of Aug. 25, 1892, showing that such fuel is extensively used abroad and with successful results, and three or four roads in this country are now using such fuel experimentally, among them being the Pennsylvania R. R., the Southern Pacific Ry. and the Long Island R. R. During the last months of 1894, the Baldwin Locomotive Works instituted some tests on a Philadelphia & Reading R. R. engine, the compound engine No. 92, having a long narrow firebox, being selected as representing the largest and worst type of engine that would be met with in adopting this fuel. The burner was placed in the fire door hole and a brick arch built over the hole on the inside. The grates were taken out and 4 ins. of brick placed at the ends and against the side sheets the entire length of the box. There was also a brick arch at the tube sheet end. The bottom of the firebox was covered with brick for about half its length from the tube sheet and for about 18 ins. at the back sheet. With this arrangement, shown in Fig. 1, the engine was found to steam freely and to burn the petroleum without smoke. The leading dimensions of the engine are as follows:

Driving wheels, diam.	6 ft. 0 ins.
Weight in working order; on drivers.	98,650 lbs.
Cylinders, h.p. (2)	14 × 24 ins.
" l.p. (2)	24 × 24 "
Boiler.—Diam. of barrel inside	5 ft. 2 "
Firebox.—Type	Radial stayed
Length inside	10 ft. 0 3-16 in.
Width inside	2 " 9⅝ ins.
Depth at front	6 " 1½ "
" at back	4 " 8½ "
Grate area	27 sq. ft.
Water space, width, sides and back, 3 ins.; front, 4 ins.	
Tubes.—Number	270
Diam.	2 ins.
Length between tube plates	14 ft. 0 "
Heating surface.—Tubes	1,965.6 sq. ft.
Firebox	169.7 "
Total	2,135.3 "
Capacity of tank	3,600 gallons

On Nov. 13, 1894, the engine hauled a freight train from Philadelphia to Baltimore, 93.2 miles, making the trip in 6 hrs. 27 mins., or 5 hrs. 14 mins. 48 secs. actual running time. The tests were satisfactory, but the engine did not steam as well when running fast as when running slowly. From Philaloaded cars, and thence to Baltimore (Canton), 64 miles, 20 cars, the approximate weight of train being

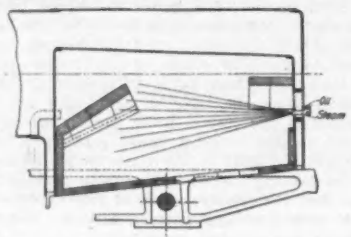


Fig. 1.

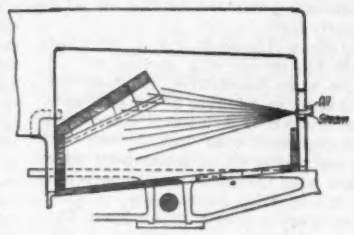
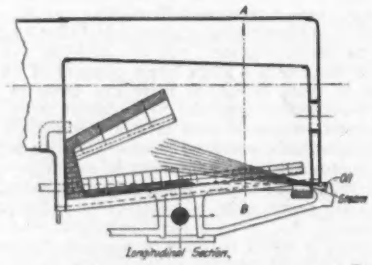


Fig. 2.



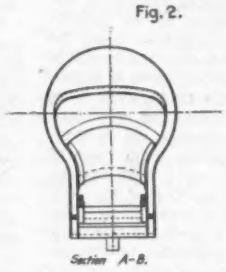
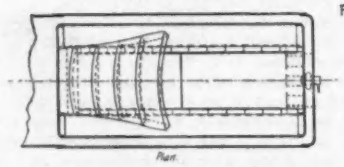


Fig. 3.



584 gross tons. After this the exhaust thimbles were reduced ¼ in. to sharpen the exhaust, and one brick was added to the arch at the front of the firebox, while the brick arch over the firedoor and 10 ins. of brick over the back end of the bottom of the firebox were removed. This arrangement, shown in Fig. 2, gave better results, and on Nov. 18 a train of 30 loaded cars was hauled from Wayne Junction to Bound Brook, 54.9 miles, the engine developing greater endurance at high speeds. It was then determined to place the burner below the firedoor, attaching it to the mud ring of the firebox and placing it so as to spray the oil upward at an angle, instead of horizontally. The brick arch was lowered, giving more area between the arch and the crown sheet; a firebrick hearth was built under the burner to catch any dropping oil; and the bricks in the bottom of the firebox were removed, a number of the grate bars being replaced and covered with firebricks. This arrangement, shown in Fig. 3, was found, on a preliminary trial, to be the best of all, as far as endurance was concerned, and the series of experiments was closed by a through trip, on Nov. 25, from Wayne Junction, Pa., to Port Reading, 52.3 miles. The results of these three trips are given in the following table:

Tests of Oil Fuel on Locomotive.

	No. 1.	No. 2.	No. 3.
Date, 1894	Nov. 13	Nov. 18	Nov. 25
Wgt., train, approx., lbs.	1,308,160	1,261,120	1,480,640
Number of cars.....	25 and 20	30	26
Length of run, miles..	89.7	54.9	52.3
	h. m. s.	h. m. s.	h. m. s.
Time of run.....	6 27 00	2 56 41	3 20 0
Running time	5 14 48	2 23 26	2 48 9
Ave. steam press., lbs.	....	171	170
Oil consump., total, lbs.	6,637	3,200.7	3,703
total, gallons	905	....	....
	lbs.	lbs.	lbs.
per hour	1,003.2	1,086.9	1,110.9
per sq. ft. of grate..	237	114.32	132.25
per sq. ft. of grate p. hr.	38.3	38.82	39.68
per sq. ft. of heat. sur.	3.13	....	....
per sq. ft. of heating surface, per hour..	0.49	....	....
Water evap.: total, lbs.	70,933	34,151.7	39,169.2
tot. from & at 212° F.	85,622	41,465.1	46,291.6
per hour	10,998	.....	.....
p. hr. from & at 212° F.	13,280	14,082.2	13,887.5
per lb. of oil.....	10.69	10.67	10.58
per lb. of oil, from and at 212° F.....	12.90	12.95	12.50
per sq. ft. of heat. sur.	33.47	16.12	18.48
per sq. ft. of heating surface, per hour...	5.19	5.48	5.54
per sq. ft. of h. sur. p. hr. from & at 212° F.	....	6.64	6.55
No. of Brit. thermal units derived from fuel to develop power.	82,685,600	40,042,868	44,703,808

On all these trips the evaporative power of the oil was practically the same, and it is computed that 1 in. width of burner for each 100 sq. ins. area of cylinder (cross-section is in this case 3.46 ins., the compound cylinders of No. 82 being equivalent to simple cylinders 21 ins. diameter), would meet all conditions of service and successfully burn the various grades of oil. When compound locomotives are

ARRANGEMENTS FOR BURNING OIL FUEL ON LOCOMOTIVES.

to be considered, it would be safe to allow 1 in. width of burner for each 600 sq. ft. of heating surface. In new engines for oil fuel the fireboxes should be as large as possible, so as to give ample room for the mixing of the air with the vaporized oil, thus ensuring more perfect combustion. The oil pipe to the burner should be not less than 1 in. diameter, as the oil moves very sluggishly at times, and it is essential that its flow should be regular. The steam jet pipe should be ¾ in. diameter. A strong blower is necessary, as the oil requires a sharper draft than soft coal, and it is recommended to use a 1-in. pipe on engines with 15-in. cylinders or larger, and ¾-in. pipe on smaller engines. It is desirable at times to have a very small supply of oil at the burner, as when standing at stations, or drifting down grade, and in order to provide for this the passage through the cock regulating the oil supply is of square section, placed diagonally, forming a diamond opening, so that no matter how small the opening may be, it will always be square and will not be so easily stopped or shut by refuse in the oil. To protect the firebox from the rapid circulation of cold air, the ashpan should have a strong cast iron frame at the back, with a machined surface, upon which an air-tight damper closes, adjusted by a lever.

The report on the experiments points out that oil has several advantages over coal: 1, no smoke if the firing is properly done; 2, no sparks; 3, no terminal labor in cleaning fires, hauling away ashes and loading coal, which labor is said to amount sometimes to 50 cts. per ton of coal consumed; 4, the engine is always ready for service; 5, the fire is always clean and there is no danger of its being torn up by a heavy exhaust or by the engine slipping. Tests of the oil used showed 84 gravity, 140 flash and 190 fire. In conclusion, it is stated that to determine the value of oil, it is necessary to know the evaporative power of the boiler for each pound of fuel burned, which depends greatly upon the ratio of heating surface to grate area, and the volume consumed in a given time. These conditions do not seem to affect the consumption of oil, the evaporation being about the same per pound of oil for all rates of combustion, it being impossible to consume the oil without a proper supply of air, and, as no smoke is made, no unconsumed fuel escapes from the smokestack, as is the case with soft coal. The following formula is given for obtaining the value of oil, as compared with coal, as a locomotive fuel, the result being the price per gallon at which oil will be the equivalent of coal. In this formula the cost of both oil and coal must be the cost delivered on the engine, and not the purchasing price:

$$A = \frac{B \times 10.7 \times 7}{2{,}000 \times C}$$

A = price per gallon at which oil will be equivalent of coal; B = cost of coal per ton, plus the cost of handling (say 50 cts. per ton); C = evaporative power of coal.

The new freight steamer "Phoenicia" of the Hamburg-American Line, which has just made her first voyage to this port, is one of five steamers built for this service. It is 480 ft. long over all, 52 ft. beam and 36 ft. deep, measuring 8,000 tons and having a registered tonnage of 7,600 gross tons. It is driven by twin screws and triple expansion surface condensing engines of 5,000 HP., the guaranteed speed being 13 knots, and the ship making the trip from Hamburg to New York in 12 days. The vessel can carry 50 first-class, 80 second-class and 2,500 steerage passengers, and has cold storage compartments with capacity for 400,000 lbs. of meat. The "Phoenicia" was built by Blohm & Voss, of Hamburg; the "Persia" and "Prussia" were built by Harland & Wolff, of Belfast, and the "Patria" and "Palatia" by the Vulcan Works, at Stettin. The latter has been launched, and is nearing completion.

The contract for furnishing about 75 derricks for use in erecting the Paris Exposition of 1900 has been secured by a Boston woman, Mrs. D. Henry Cram, says the Boston "Post." The same journal says that Mrs. Cram has had previous experience in contract work in the construction of Basins 5 and 6 of the Boston waterworks. She is a member of the Professional Woman's League, of New York, and of the Boston branch of the Business Woman's League. In 1892 she is said to have made a professional inspection and report upon the dock system of London.

The annual report of State Engineer Adams on the state canals recommends the deepening of the Erie and Oswego canals to 9 ft. and of the Champlain Canal to 7 ft., wherever possible without radical changes in existing structures. He would lengthen all single locks on the Oswego and Erie canals which cannot be combined and replaced by high-lift locks. The latter, he says, would economize in water used and in time and expense of transfer. He recommends the use of electricity for towing, by trolley motors running on their own tracks. He would put these motors on elevated tracks outside the tow-path and high enough to permit animals to pass under the towing lines.

Good progress was made on the municipal water power, water-works and electric lighting plant at Austin, Tex., during the year ending Nov. 30, 1894, according to the annual message of Hon. John McDonald, Mayor, and Mr. W. J. Oliphant, Secretary of the Board of Public Works. At least once during the year the depth of water flowing over the crest of the new masonry dam was 6 ft. and 11 ins. The dam is about 60 ft. high, and the crest is 1,150 ft. in length. The power house was well under way at the time of the report. It will be 54 ft. wide and 197 ft. long, with a height on the stream side of 112 ft. from bedrock to the top of the wall. Two 200-HP. upright Victor turbines will drive two pairs of pumps, with a daily capacity of 4,000,000 gallons each. Four pairs of 500-HP. horizontal Victor turbines will be used for the electrical plant, two pairs being belted direct to four 3,000-light generators; the other two pairs will operate two countershafts, from which will be driven two 1,500-light generators, three 80-light arc machines, two 125-light generators, and one three-phase generator of 250 HP. A total of 500 HP. will be available for commercial power. Of some 200 arc lamps of 2,000 c. p., 180 will be placed, six each, on 31 wrought iron towers, each 150 ft. high. The electric work is being done by the Fort Wayne and General Electric Cos. Mr. J. T. Fanning, M. Am. Soc. C. E., has been continued as consulting engineer for the work, and Mr. Frank E. Scoville has served as electrical engineer. Since the death of Mr. Gorham P. Low, M. Am. Soc. C. E., early in the year, Mr. Joseph Kepferle has served as engineer-in-charge at the dam, and Mr. C. K. Donald has been assistant since March 1, 1894. Mr. E. H. Kellogg, of Denver, was called in for a time for engineering services in connection with work on the power house foundations. Mr. Rhoads Fisher, Jr., served as engineer for the construction of the water distribution system, which has been very nearly completed. Detailed information in relation to the work at Austin, especially that pertaining to the dam, has been given in our issues of July 11, 1891; Aug. 18, Sept. 29, Nov. 10 and Dec. 22, 1892; Jan. 26, Feb. 23, June 8, June 29, July 27, Sept. 28 and Oct. 19, 1893; Jan. 25 and June 14, 1894.

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PERSONALS.

Mr. Henry L. Cook has been appointed Superintendent of Streets at Woonsocket, R. I.

Mr. E. Sherman Gould, M. Am. Soc. C. E., left New York on Feb. 5 for Zacatecas, Mexico. He expects to return about March 1.

Mr. Geo. H. Frost, of this journal, and Mrs. Frost, sailed on the "Paris" for Southampton, this week, intending to be absent until late in April.

Col. Cyrus G. Comstock, U. S. Engineers, has been retired, having reached the age of 64. He has been president of the Mississippi River Commission for some years.

Mr. Robert Laidlaw, President of the Laidlaw-Dunn-Gordon Pump Co., of Cincinnati, has been elected Treasurer of the National Association of Manufacturers.

Mr. Gustave Von Leibhause, civil engineer, of Berlin, Germany, is visiting this country for the purpose of examining the system of sewerage and sewage disposal of the large cities.

Mr. William Thornburgh has been appointed General Superintendent of the Columbus, Sandusky & Hocking R. R., with headquarters at Columbus, O., vice Mr. H. O. Pond, resigned.

Mr. Edward A. Berry, contractor, of Kansas City, Kan., died Jan. 26, at the age of 55. He built the elevated railway structure between the Union Station and the Kaw River in 1885-86.

Mr. Charles Walcott, Director of the U. S. Geological Survey, has had the Bigsby medal awarded to him by the Geological Society, of London, for his services in geological and paleontological work.

Mr. Charles A. Young has been appointed Deputy Superintendent of the Sanitary Division of Boston, vice the late Mr. Geo. H. Forrestall. Mr. Young is the inventor of an odorless excavating system.

Mr. Thomas Quayle, the head of the shipbuilding firm of Thomas Quayle & Sons, of Cleveland, O., died Jan. 31. He was born in the Isle of Man, Great Britain, in 1811, and came to this country in 1827.

Mr. James M. Phillips, General Superintendent and Master Mechanic of the Kentucky Union R. R. and Lexington Belt Line, died Feb. 4 at Dallas, Tex., where he had gone for his health. He was 50 years old.

Messrs. J. M. Simpson, of McPherson, Kan.; Joseph G. Lowe, of Washington, Kan., and Samuel T. Howe, of Topeka, Kan., have been appointed to constitute the new Kansas State Board of Railroad Commissioners.

Ensign Robert B. Dashiell, U. S. N., has been appointed Assistant Naval Constructor, and will have charge of the design and construction of such matters as turrets and turret gear, gun carriages and ammunition hoists.

Mr. C. L. Strobel, M. Am. Soc. C. E., late Consulting Engineer of the Carnegie Steel Co. and Chief Engineer of the Keystone Bridge Co., has moved his office from the Home Insurance Building to the Monadnock Block, Chicago.

Mr. Burr Bassell, of the firm of Bassell, Olmstead & Bennett, civil engineers, of Los Angeles, Cal., has resigned his position as an assistant in the office of the City Engineer of that city, and will devote himself entirely to private practice.

Mr. Benjamin Ayerigg, a civil engineer, died at Lakewood, N. J., on Feb. 3. Mr. Ayerigg was born in New York city on Sept. 24, 1804. He graduated from Columbia College in 1824 and became a civil engineer. He was State Engineer of Pennsylvania for some time and, under Gov. Ritner, he was Superintendent of the Pennsylvania State Canals.

Prof. J. W. Votey, of Burlington, and Messrs. O. L. Hinds, of Highgate, and Marcus Peck, of Brookfield, have been appointed Highway Commissioners of Vermont by Gov. U. A. Woodbury. Col. G. W. Hooker, of Brattleboro, was chairman of the last commission, but resigned some time ago.

Mr. Samuel A. Miller, of Louisville, Ky., president of the well-known pipe foundry firm of Dennis Long & Co., was killed by a train at Asheville, N. C., Feb. 2. Mr. Miller was also president of the East End Improvement Co., of Louisville, which built the Louisville & Jeffersonville bridge.

Mr. William B. Taylor, of Utica, N. Y., died Feb. 2, at the age of 71. He was engaged on the Erie Canal from 1848 to 1851, and later had charge of much of the work of enlarging the canal and locks. He was State Engineer from 1861 to 1865 and again in 1872, and was City Surveyor of Utica in 1851, 1878 and 1885.

Mr. Isaac F. Chapman, of Brooklyn, N. Y., the founder of the large shipbuilding and shipowning firm of I. F. Chapman & Co., died Jan. 30, at the age of 82. He was born at Damariscotta, Me., in 1812, where his father had a shipbuilding business, and in 1868 the shipyard was moved to Bath, Me., while the shipping business was moved to Brooklyn, N. Y., in 1858.

Mr. Walter C. Quincy, long identified with various railway interests, died at Pittsburg on Feb. 3, aged 64 years. Mr. Quincy was born in Baltimore and was long connected with the Baltimore & Ohio R. R., and during the Civil War he had charge of the maintenance of way on that line. After the war he was placed in charge of the B. & O. lines west of the Ohio River, and in 1878 was transferred to the Pittsburg & Lake Erie Ry. In later years he was connected with the shipping and railway interests of Jones & Laughlin, of Pittsburg, Pa.

Mr. E. J. Farrell, General Manager of the firm of Ryan & McDonald, which has just completed the Baltimore Belt Line Ry. tunnel, gave a dinner to the superintendents and bosses on that work at Baltimore on Jan. 28. Speeches were made by Mr. W. T. Manning, Chief Engineer of the Baltimore & Ohio R. R. Co.; by Mr. H. B. Reid, engineer for the contracting firm, and several others. The tunnel workmen presented Mr. Farrell with a silver salad dish, 3 ft. in diameter, surmounted by the kneeling figure of a miner, pick in hand, with views of the tunnel in repousse work on the sides. The presentation speech was made by Mr. T. Wallis Blakistone, of the counsel for the contractors.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

MONTANA SOCIETY OF CIVIL ENGINEERS.
Feb. 9. Secy., G. O. Foss, Helena, Mont.
ENGINEERS' CLUB OF INDIANAPOLIS.
Feb. 9. "Art and Engineering," by L. H. Gibson. Secy., C. C. Brown, City Engineer.
WISCONSIN PEWTERERING SOCIETY.
Feb. 11. Secy., Geo. G. Mason, 144 8th St., Milwaukee.
ENGINEERS' CLUB OF KANSAS CITY.
Feb. 11. Secy., F. W. Tuttle, Baird Building.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Feb. 12. Secy., F. C. Osborn, 721 Rickox Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
Feb. 12. Secy., D. W. McMorris, Burke Building, Seattle, Wash.
NORTHWESTERN RAILWAY CLUB.
Feb. 12. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
DENVER SOCIETY OF CIVIL ENGINEERS.
Feb. 12. Secy., F. Ed. King, 36 Jacobson Block.
NEW ENGLAND RAILROAD CLUB.
Feb. 13. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.
NEW ENGLAND WATER WORKS ASSOCIATION.
Feb. 13. Adjourned quarterly meeting at Young's Hotel, Boston. "Some Observations on the Temperature of Surface Waters, and the Effect of Temperature on the Growths of Micro-Organisms," by G. C. Whipple, Biologist, Boston Water-Works; "Card System of Service Locations," By A. W. F. Brown. Secy., Dexter Brackett, Boston, Mass.
ENGINEERS & ARCHITECTS' CLUB OF LOUISVILLE.
Feb. 14. Secy., Jas. K. Zollinger, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
Feb. 14. Secy., H. D. Runn, Nashville, Tenn.
FRANKLIN INSTITUTE, PHILADELPHIA.
Feb. 15. "Sanitary Engineering," by W. P. Gerhard. Secy., W. H. Wahl, 16 South Seventh St., Philadelphia.
ENGINEERS' CLUB OF PHILADELPHIA.
Feb. 16. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERS' CLUB OF MINNEAPOLIS.
Feb. 18. Secy., E. Nexsen, Kasota Block.
COLUMBIAN ENGINEERING SOCIETY.
Feb. 19. Secy., W. F. Hart, Washington, D. C.
WESTERN RAILWAY CLUB.
Feb. 19. Secy., W. D. Crosman, Club Room 9, Grand Pacific Hotel, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Feb. 20. Secy., J. H. Pilcher, Roanoke, Va.
ENGINEERS' AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
Feb. 20. Secy., F. Van Vleck, Los Angeles, Cal.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Feb. 20. Secy., S. E. Tinkham, City Hall. Rooms, 36 Bromfield St.
ENGINEERS' CLUB OF ST. LOUIS.
Feb. 23. "Mechanics of Soaring Flight," E. D. Meier. Secy., W. H. Bryan, Turner Block.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Feb. 20. Secy., Francis Collingwood, 127 E. 23d St., New York.
NEW YORK RAILROAD CLUB.
Feb. 21. Secy., John A. Hill, 256 Broadway, N. Y. City.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Feb. 21. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
Feb. 21. Secy., J. F. Wilson, 24 W. 4th St.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Feb. 21. Secy., C. H. McLeod, 12 Mansfield St., Montreal.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Feb. 27. Secy., F. R. Hutton, 12 W. 31st St., New York.
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Feb. 27. "Notes on Recent Electrical Engineering Developments in France and England," by H. W. Leonard. Secy., R. W. Pope, 12 W. 31st St., New York city.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
March 1. Secy., O. H. Von Geldern, 719 Market St., San Francisco.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
March 4. Secy., C. L. Annan, City Engineer's Office.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
March 4. Secy., Geo. R. Sikes, Buffalo, N. Y.
WESTERN SOCIETY OF ENGINEERS.
March 6. Secy., Chas. J. Rosey, 1736 Monadnock Block, Chicago.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
March 15. Secy., D. W. Meeker, St. Paul, Minn.
CENTRAL RAILWAY CLUB.
March 27. Secy., H. D. Vought, Buffalo "Courier," Buffalo N. Y.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
April 18. Atlanta, Ga., Secy., F. A. Charpiot, Macon, Ga.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.—The annual meeting was held at the house of the American Society of Mechanical Engineers, New York, Jan. 22 and 23. The president, Mr. E. P. Bates, of Syracuse, N. Y., in his opening address, suggested that the subject of the ventilation of tenements should be taken up, as well as that of the heating and ventilation of factories, and in regard to tenement buildings suggested that legislation should be secured to compel every person or corporation who shall in future erect a tenement house, to connect each room to an individual ventilating flue, not less than 8 ins. internal diameter, round in form, and preferably of glazed tile, built in the walls of the building. The secretary's report showed a membership of 75, and the treasurer's report showed a balance of $493 in the treasury.

A paper by Mr. J. H. Kinealy, on "Determining the Heating Power of Heating Systems," was read by the secretary. His method of testing in warmer weather for the heating power at a zero temperature assumes that the heat given out by the radiators and the heat passing through the walls of the building should be equal in order to maintain a constant interior temperature, and that the transfer of heat would be approximately proportional to the difference in temperature. Mr. J. J. Wilson, in a paper on "The Construction of Hot Water Radiators," said that he thought the quality of the iron affected the radiating efficiency, and that the volume of water in the radiator affected the efficiency of the boiler. There was some discussion as to whether the heating should be by radiation (independent of the ventilating air supply), or by the air for ventilation. A paper on "The Commercial View of the Heating and Ventilating Engineer," was then read by Mr. S. A. Jellett, in which he pointed out the defects of much work done by contractors who prepared their own plans, and referred to the fact that architects do not always pay for having the heating and ventilating systems worked out in their building plans. He had adopted the practice of charging for such work and found the results satisfactory. The subject of air ducts and dampers was then discussed and in the course of a short discussion as to what would be the future of electric heating, Mr. Hart said that from inquiries he had made he was sure the expense would always prevent it from becoming a formidable competitor to other systems. Two other papers were presented, as follows: "Heating and Drying by the Use of Exhaust Steam and Live Steam Reduced to Low Pressure," by A. A. Hunting, and "The Testing of Steam Radiators," by Prof. R. C. Carpenter.

Officers for the ensuing year were elected as follows: President, C. W. Norton, Baltimore, Md.; Vice-Presidents, W. M. Mackay, New York city; Charles Onderdonk, Philadelphia, Pa.; Secretary, L. H. Hart, New York city; Treasurer, J. A. Goodrich, New York city.

CENTRAL RAILWAY CLUB.—The annual meeting was held at the Iroquois Hotel, Buffalo, N. Y., Jan. 23, The President, Mr. A. T. Waitt, in his opening address, said that he thought meetings should be held every two months, instead of four times a year, and he approved of the proposed amendment by which every other year a member of the motive power department should be chosen president, as hitherto the office has been held only by representatives of the car department. The Secretary and Treasurer, Mr. S. W. Spear, presented his report, showing a total membership of 231; the financial statement showed receipts of $2,125, and expenditures of $1,381, leaving a balance of $744. A committee of five was appointed to consider the revision of the constitution and by-laws. The paper by Mr. Morford, on "Terminal Yards," presented in March, 1894, was discussed, and Mr. J. D. McIlwain presented the report of the committee on Car Door Fastenings. He said that, in his judgment, a proper car door, properly hung, that will adequately protect freight in transit, without too great an expense for maintenance, was the most important question now before the car departments. Mr. Curtis, Secretary of the New England Railroad Club, exhibited a model of

a patent car door hanger manufactured by a firm at Cambridgeport, Mass., and read a paper descriptive of the design, construction, and merits of the device. It is in practical use on a number of cars in the East. The discussion of this subject will take place at the next meeting. The election of officers resulted as follows: President, Samuel Higgins, South Bethlehem, Pa., Superintendent Motive Power, Lehigh Valley R. R.; Vice-President, E. D. Bronner, Detroit, Master Car Builder, Michigan Central R. R.; Secretary and Treasurer, Harry D. Vought, Buffalo "Courier;" Executive Committee, T. A. Bissel, Manager, Wagner Car Works, Buffalo; John MacKenzie, Cleveland, Superintendent Motive Power, New York, Chicago & St. Louis R. R.; O. P. Letchworth, Buffalo; George W. West, Superintendent Motive Power, New York, Ontario & Western Ry., Middletown, N. Y.; C. E. Rood, Buffalo; P. H. Griffin, Buffalo.

INDIANAPOLIS ENGINEERING CLUB.—At the meeting on Jan. 26. Mr. Arthur Boothby presented a paper on "Air Compressors." In constructing air compressors, two methods are used to reduce the rise in temperature, one, by a water jacket around the air cylinder; the other, by spraying water directly into the cylinders. The latter method is more efficient, but requires heavier and slower moving machinery, giving greater frictional resistance. Reheating the compressed air near or in the engine has been tried with much success. By this method an efficiency of 95% has been attained. An interesting discussion followed. The club has just completed its first half year, has 72 members, and has furnished a room for library and meeting purposes .The list of officers for the ensuing year is as follows; all the officers being re-elected: President, Morris M. Defrees; Vice-Presidents, T. O. Morris and W. B. Poland; Recording Secretary, Howard A. Dill; Corresponding Secretary, Chas. C. Brown, City Engineer; Treasurer, Rollin Defrees; Librarian, J. W. Brain.

NEW PUBLICATIONS.

WHY DO DIFFERENT MAGNETIC NEEDLES NOT ALWAYS POINT IN THE SAME DIRECTION THOUGH OBSERVED AT THE SAME PLACE AND TIME? By C. Louis Berger, of the firm of Buff & Berger, Boston, Mass. 8vo; pp. 7; illustrated.

This is a paper read at the annual meeting of the Michigan Engineering Society at Lansing, Mich., Jan. 15 to 17, 1895.

THIRD REPORT OF THE BUREAU OF MINES.—Published under the direction of Archibald Blue, Director of the Bureau of Mines, Toronto, Ont. Paper; 8vo; pp. 295; illustrated.

This report gives the statistics of mineral production and of mining lands in the province for the year 1893, and also particulars of the various deposits and the work done in the way of working, developing and exploration.

COTTON STATES AND INTERNATIONAL EXPOSITION.—Classification of exhibits; 8vo; pp. 82. Rules as to entrance, admission fees, etc.; 8vo; pp. 7. C. A. Collier, President, Atlanta, Ga.

This exposition is to held at Atlanta, Ga., from Sept. 18 to Dec. 31, 1895. We published information respecting it in our issue of Jan. 31.

THE EVOLUTION OF A SWITCHBOARD.—By Arthur V. Abbott, C. E. Published by the University of Wisconsin, Madison, Wis. 8vo; paper; pp. 100; illustrated. Address the Librarian, enclosing postage, 3 cts.

This is a lecture delivered before the students of the College of Mechanics and Engineering, and describes in detail the various parts of the switchboard, and the method of operation.

STATE BOARD OF HEALTH OF OHIO: Report for the year ending Oct. 31, 1893. C. O. Probst, M. D., Columbus, Secretary. 8vo; cloth; pp. 413; tables.

This belated report contains some reports and descriptions in relation to water supply and sewerage, including a description of the sewage-disposal works at Canton, O., described in Engineering News of June 1, July 20 and Sept. 14, 1893.

THE CYANIDE PROCESS. Its Practical Application and Economical Results. By Dr. O. Scheidel, E. M. Report to Mr. J. J. Crawford, State Mineralogist. Bulletin No. 5, California State Mining Bureau, San Francisco, Cal. 8vo; pp. 140; illustrated. Sent on receipt of postage, 4 cts.

This report takes up the history and chemistry of the cyanide process for the extraction of gold and silver from the ore, and describes the methods of operation at American and foreign works.

THE ARTESIAN WELLS OF SOUTHERN WYOMING: Their History and Relation to Irrigation. Bulletin No. 20 of the Wyoming Experiment Station, University of Wyoming. By J. D. Conley, Physicist and Meteorologist of the Station. 8vo; paper; pp. 45; two illustrations. Address Director Experiment Station, Laramie, Wyo., for free copies.

This pamphlet discusses briefly artesian wells in general, and then describes some of the wells sunk in Wyoming, presenting analyses of the water from a number of these.

IRRIGATION ALONG THE ARKANSAS IN WESTERN KANSAS. By E. C. Murphy, M. Am. Soc. Irrigation Engineers. Reprinted from the Kansas University Quarterly, vol. III., No. 2, October, 1894. 8vo; paper; pp. 12; one folding plate. Addresses the author, Lawrence, Kan.

The information here presented by Mr. Murphy was secured on a bicycle trip up the Arkansas Valley, and from reports on irrigation. A map shows the irrigation canals along the portion of the river visited.

REPORT OF THE IRRIGATION COMMISSION OF THE TERRITORY OF UTAH to the Third National Irrigation Congress Assembled at Denver, Colo., Sept. 3 to 10, 1894. Compiled and prepared by Charles L. Stevenson, C. E., Secretary of the Commission. Address the author, Salt Lake City. 8vo; paper; pp. 24.

Utah irrigation statistics and the opinions of the Commission in relation to National legislation on the arid lands and irrigation comprise the greater part of this pamphlet.

TWELFTH REPORT OF THE STATE MINERALOGIST. Report for the two years ending Sept. 15, 1894. By J. J. Crawford, State Mineralogist, California State Mining Bureau, San Francisco, Cal. 8vo; pp. 541; illustrated. Sent on receipt of postage, 14 cts.

In addition to statements regarding each individual mine, and the statistics of all mineral products, this volume contains special papers, including one by Mr. T. H. Leggett on "Electric Power Transmission Plants and the Use of Electricity in Mining Operations." The report is profusely illustrated by cuts, half-tone engravings and maps.

REPORT OF A SPECIAL COMMITTEE OF THE CHICAGO COUNCILS, appointed by the Mayor to collate all information obtainable on the subject of Pavements, with a view to selecting material for permanent pavement. M. B. Madden, Chamber of Commerce Building, Chairman, Chicago, Ill. Pamphlet; 8vo; 35 pp.

This is a collation, as the title implies, and much of its contents have already appeared in this journal. The conclusions of the committee are chiefly truisms familiar to engineers. The bulk of the report is taken up with extracts from consular reports upon foreign paving practice and from published reports of city engineers in this country. The chief value of this pamphlet is that it gathers a quantity of this class of paving information, which is scattered in a great number of places, into one publication.

PUBLIC WORKS DEPARTMENT OF SOUTH AUSTRALIA. Report for the year ending June 30, 1894. J. G. Jenkins, Commissioner; Alex. B. Moncrieff, M. Inst. C. E., M. Am. Soc. C. E., Engineer-in-Chief. 4to; paper; pp. 79; illustrations. Adelaide, So. Australia. Pub. Doc.

This report contains a considerable amount of interesting information in relation to the progress of irrigation and other water-supply developments in South Australia, and detailed statements and figures in regard to these subjects and to harbors, jetties, wharves and lighthouses, roads and bridges, military defences and public buildings and the Adelaide sewers and sewage farms. Maps and diagrams are presented to illustrate various phases of the work. The report states that efforts now in progress since 1885 to secure joint action in utilizing for irrigation the waters of the River Murray on the part of South Australia, Victoria and New South Wales have thus far been unsuccessful through the failure of the latter government to co-operate with the others.

ADVANCE IN FREIGHT RATES.—Issued by the Board of Railroad Commissioners of Iowa, Des Moines, Ia. Paper; 8vo; pp. 51.

This pamphlet contains the petition and arguments for and against the revision of the schedule and classification, and for an increase in maximum rates, as applied for by the Illinois Central, the Chicago, Milwaukee & St. Paul, the Chicago & Northwestern, the Chicago, Rock Island & Pacific, the Chicago, Burlington & Quincy, and the Burlington, Cedar Rapids & Northern railways. The application states that long experience has proved the present rates to be inadequate and unremunerative, which was denied by shippers, who protested against any higher rates. The decision of the Board, rendered Jan. 12, was to the effect that the claim of the railway companies was not established, and that it would not justify the Board in revising the schedule by increasing the rates as asked. One of the three commissioners, however, presented a dissenting report.

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON AERIAL NAVIGATION.—Held in Chicago, Aug. 1, 2, 3 and 4, 1893. New York, "The American Engineer and Railroad Journal." 8vo; 429 pp.; cuts and diagrams; $2.50.

The rapidly-growing interest in the problem of aerial navigation is nowhere better shown than in the fact that the Chicago conference upon this subject brought out 35 voluminous papers, covering many of the knotty problems presented in attempted man-flight, and embodying the observations and experiments of the foremost investigators in this line of research, and the views of experts and engineers upon the mechanical questions involved. These interesting papers and the no less interesting discussions upon them are here given in full, in handsome form. Nearly all civilized nations are represented among the writers, and among the United States contributors we find such names as Langley, Chanute, Thurston, De Volson Wood, I. Woodbridge Davis, Harrington and Hazen. A brief report of the proceedings was given in our issue of Aug. 17, 1893.

REPORT OF THE RAILROAD COMMISSIONERS OF THE STATE OF MAINE. The 36th Annual Report, with Annual Certificates to Railroad Corporations, and with Statistical Tables Compiled from the Annual Returns of the Railroad Companies for the year ending June 30, 1894, including Petitions, Decisions and Rules of the Board made during the year 1894. Published by the Board. Augusta, Me. Cloth; 8vo; pp. 486; illustrated; folding map.

The report shows a mileage of 1,516 miles, or 116 miles more than in 1893, while there are 80 miles of street railway, being an increase of 4¼ miles. The freight and passenger business showed a falling off, owing to the business depression, but the outlook is said to be encouraging. In accidents, 2 passengers were killed and 4 injured, and 7 employees were killed and 31 injured. There are statements as to the physical condition of each road, and reports of the investigations as to accidents, grade crossings, complaints, etc. The abstract of the returns of the railway companies and the statistical tables occupy 337 pages. The illustrations consist of six half-tone engravings of bridges, etc., and a portrait of Mr. A. W. Wildes, who has been one of the Commissioners since 1861.

REPORT OF THE BOARD OF RAILROAD COMMISSIONERS OF NORTH CAROLINA. Fourth Annual Report; for the Year Ending Dec. 31, 1894. Published by the Board, Raleigh, N. C. Cloth; 8vo; pp. 675.

The report states that the financial condition of the companies is bad, owing to the great business depression, and three of the largest systems of the state were forced to go into the hands of receivers, namely, the Richmond & Danville, the Cape Fear & Yadkin Valley, and the Carolina Central, but the first of these has since been fully reorganized, and is now on a solid basis. During the year 29.30 miles were constructed and 30 miles abandoned. The report gives the laws relating to the commission, the standard freight and passenger tariffs, and the tariffs of the several roads, freight classifications, and reports and decisions of the Board, most of which relate to freight rates and complaints. This part covers 233 pages. Part 2 gives the details of the assessment of railway property, telegraph, steamboat and canal companies. The tabular compilation of returns from the railways occupies 386 pages, and in addition to the tables there is given a summary of the history of each road. The statistics enter very closely into financial statements, cost of transportation, fuel consumption, renewals of rails and ties, accidents, etc., but there is no general summary of this matter.

OHIO SOCIETY OF SURVEYORS AND CIVIL ENGINEERS.—Fifteenth Annual Report, being the Transactions of the Society at its Fifteenth Annual Meeting, held in Cleveland, O., Jan. 16, 17, 18 and 19, 1894. Secretary, Charles A. Judson, Sandusky, O. Paper; 8vo; pp. 180; illustrated; 50 cts.

This report includes the general proceedings of the meeting, addresses made, papers presented, surveying problems, and the reports of committees on Legislation, Civil Engineering, Highways, Drainage, Land Surveying, and Blanks and Instruments. The papers presented and discussed are as follows: "The Legal Status of the Civil Engineer," W. H. Searles; "The Future of the Canal," R. A. Bryan; "Testing Cements," Prof. S. B. Newberry; "The Sewer System of Oberlin," W. B. Gerrish; "Pavements of Youngstown," M. Lilly; "Cleveland Water-Works, Lake and Land Tunnel No. 2," M. W. Kingsbey; "Some Phases of Railway Work," J. A. Hanlon; "Instruments Used in Land Surveying Discussed by an Egotist," J. D. Varney; "My Mistakes," G. S. Innis; "Accuracy of Measurement," Prof. Cady Staley; "Location of Boundaries of Streams," H. M. Gates; "Electricity as a Factor in Engineering," J. B. Strawn; "Hoist Bridge across the Miami Canal at Keowee St., Dayton, O," G. R. Stattlemann.

THE MEASUREMENT AND DIVISION OF WATER: Bulletin No. 27 (Third Edition, Revised, of Bulletin No. 13) of the Agricultural Experimental Station of the State Agricultural College of Colorado. By Prof. L. G. Carpenter, Meteorologist and Irrigation Engineer. 8vo; paper; pp. 42; seven illustrations and six tables. Address Director of the Experiment Station, Fort Collins, Colo.

The first edition of this pamphlet was noticed at length in our issue of March 14, 1891. The author states that in preparing the third edition he has practically rewritten and has added to the matter presented in the first.

Prof. Carpenter is well fitted by observation at home and abroad and by experiment and practice in Colorado to write on this subject. That he has treated

the matter ably is shown by the fact that two editions of the bulletin have been exhausted.

The author presents in brief compass a description and discussion of a number of devices employed for measuring and dividing water on irrigation works, or on any other works where quantities of water are to be determined under similar conditions.

Of the six tables in this edition of the bulletin, only two were given in the first edition, one being the "Discharge over Rectangular Weirs, With and Without Contraction," and the other being "Discharge Over Cippoletti's Trapezoidal Weir of Various Lengths and With Various Depths, and Over Rectangular Weirs Without Side Contraction." Two of the new tables give the discharge over weirs 1 in. and 1 ft. long, respectively; another gives corrections in per cents for velocity of approach to be applied to the values obtained from the four tables just mentioned; the remaining table is entitled "Auxiliary Table for Approximating to Velocity of Approach."

TRADE PUBLICATIONS.

SEWER PIPE.—Blackmer & Post, St. Louis, Mo. Card, 11 x 13 ins.

This card has in tabular form the Western price list of standard vitrified, salt-glazed pipe, in 2½-ft. lengths, with corrugated deep sockets; also curves, junctions, traps, etc.

FILES.—Nicholson File Co., Providence, R. I. 4to; cloth; pp. 60.

This illustrated catalogue contains illustrations of files of every description and for every kind of use, from heavy machine files to the fine tools used by watchmakers, etc. The works have a capacity of 1,200 dozen files per day. Besides files, there are special tools such as scrapers, rifflers, rasps, etc.

DRIVING WHEELS.—Swinerton Wheel Co., 27 State St., Boston, Mass. 8vo., pp. 32, illustrated.

This pamphlet describes the Swinerton "polygonal" wheel which was tried on locomotives some years ago, and more recently on electric cars. It was discussed in our issues of May 24 and June 28, 1890, and the pamphlet says nothing concerning any tests on locomotives since that time.

PRESSURE REGULATORS AND PUMP GOVERNORS.—Foster Engineering Co., Newark, N. J. 12mo; pp. 40; illustrated.

This little pamphlet contains interesting information relative to pressure regulators, and shows different forms of the Foster device, including the steam reducing valve used in the steam heating of trains, and also an inside safety check for locomotive boilers. It is stated that more than 20,000 regulators have been sold by this company for all kinds of service.

MODELS AND TOOLS.—A. J. Weed & Co., 106 Liberty St., New York city. Paper; 8vo; pp. 163; illustrated.

This firm makes a specialty of models and experimental work for inventors; tools and supplies for amateurs, inventors and mechanics; models and apparatus for schools and colleges, etc. The catalogue includes all kinds of tools, nuts and screws, electrical apparatus, etc. Among the specialties are vertical tubular boilers of ⅛ to 1 HP. and a gas engine of ¼ HP., suitable for laboratory and experimental work.

AIR AND GAS COMPRESSORS.—Rand Drill Co., 23 Park Place, New York city. 8vo., paper, pp. 31, illustrated.

This pamphlet consists principally of half-tone engravings of various kinds of compressing plants, operated by steam and water power, including compressors or pumps for natural gas pipelines and for compressing oxygen and hydrogen gases to pressures of 2,000 lbs. per sq. in. There are also particulars of a test of air-brake pumps and flywheel air compressors for railway shop use, and descriptions of the air-lift pump and the coast defense pneumatic dynamite guns. Pneumatic locomotives are said to be in use at the works of the Plymouth Cordage Co.

STEAM ROAD ROLLERS. The O. S. Kelly Co., Springfield, O. Oblong 4to; pp. 31; illustrated.

This is a very handsome and effective trade publication, containing a description of the Springfield steam roller, 20,000 to 36,000 lbs. weight, for ordinary roads, and a five-ton roller with vertical boiler for asphalt pavements. The heavier engines have a special form of fore-carriage, beveled wheels, open footplate, rocking grate, automatic governor, etc. There are 10 pages of good half-tone engravings showing the rollers in operation in a large number of towns, etc.; and finally there are notes on steam vs. horse rolling, repairing gravel and macadam roads, and the making of roads and pavements.

ELECTRIC HOIST AND CONVEYOR.—McMyler Mfg. Co., Cleveland, O. Oblong 4to; pp. 12; illustrated.

This pamphlet contains three handsome half-tone engravings of the Chamberlin electric hoist and conveyor in the warehouse of the Spreckels Sugar Refining Co., Philadelphia, Pa. There are 12 in use, with an average load of 3,000 lbs.; average speed of hoist, 40 ft. per minute, and average speed of travel along tracks, 600 ft. per minute. There are 13 switches, and the sharpest curve is 18 ft. radius. The machine is hung below a truck running on an overhead track, and is controlled by a man riding upon it.

MANNING BOILERS.—The Bigelow Co., New Haven, Conn. Paper, oblong 8vo; pp. 34; illustrated.

The Manning boiler is a vertical tubular boiler already in extensive practical use, and in this pamphlet details are given of a test of a battery of nine boilers in the works of the Bristol Mfg. Co., at New Bedford, Mass. The boilers were 5 ft. diameter, with 180 tubes, 2½ ins. diameter and 15 ft. long, the grate area being 28.7 sq. ft.; heating surface, 1,383 sq. ft., and superheating surface, 471 sq. ft. The evaporation was 9.25 lbs. of water per pound of coal. The net heat utilized for the evaporation of steam was equivalent to an evaporation of 13.43 lbs. of water from and at 212° F., which represents an efficiency of 84.3% for the boiler.

SEWAGE DISPOSAL.—The National Sewage Purification & Disposal Co., Milwaukee, Wis. Paper; pp. 8.

This company has a patented process of continuous chemical precipitation combined with subsequent filtration. Two chemicals are used, one after the other, but what they are is not stated. Mechanical devices are employed to regulate the amount of chemical in accordance with the flow of sewage. Mechanical filters are mentioned in the pamphlet, and it is stated that "one series of our filters has not only a mechanical, but also a chemical, i. e., oxidizing effect." No further details are given, and there is nothing to indicate what degree of purification may be attained by the process, except the assumptions of the company that it is far superior to any other method. Some of the statements in relation to sewage purification by other means are misleading, as is almost always the case when the claims of a patented process of sewage disposal are being urged.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Feb. 9.	Building plans,	Dallas, Tex.	Jan. 3
Feb. 9.	Water-wks. extensions,	New Orleans.	Jan. 10
	Advertised, Eng. News, Jan. 10 to 31.		
Feb. 9.	Electric light bonds,	Morrisville, Vt.	Jan. 31
Feb. 9.	Brick paving, etc.,	East St. Louis, Ill.	Feb. 7
Feb. 9.	Sewers,	East St. Louis, Ill.	Feb. 7
Feb. 11.	Jail,	Beaumont, Tex.	Dec. 13
Feb. 11.	Stand-pipe, etc.,	Dunlap, Ia.	Jan. 17
Feb. 11.	Electric wiring,	Dallas, Tex.	Jan. 17
Feb. 11.	Macadamizing, etc.,	Wabash, Ind.	Jan. 31
Feb. 11.	Macadamizing,	Sparta, Wis.	Jan. 31
Feb. 11.	Ferry depot,	San Francisco, Cal.	Jan. 31
Feb. 11.	Grading and filling,	Oshkosh, Wis.	Jan. 31
Feb. 11.	Electric light bonds,	Oxford, Mich.	Jan. 31
Feb. 11.	Water bonds,	Oxford, Mich.	Jan. 31
Feb. 11.	Plans for city hall,	Antigo, Wis.	Jan. 31
Feb. 11.	Dredging,	Boston, Mass.	Jan. 31
	Advertised, Eng. News, Jan. 31		
Feb. 11.	Grading,	Harrisburg, Pa.	Feb. 7
Feb. 11.	Paving,	Washington, D. C.	Feb. 7
Feb. 11.	School buildings (8),	St. Louis, Mo.	Feb. 7
Feb. 12.	Water-works system,	Forest City, Ia.	Jan. 24
Feb. 12.	Bridge,	Butte, Mont.	Jan. 31
Feb. 12.	River improvement,	Columbus, O.	Jan. 31
Feb. 12.	Boiler and chimney,	Boston, Mass.	Feb. 7
Feb. 12.	Macadamizing,	Trenton, N. J.	Feb. 7
Feb. 12.	Pier repairs,	Cleveland, O.	Feb. 7
Feb. 12.	Harbor improvements,	Cleveland, O.	Feb. 7
Feb. 13.	Enlarging asylum,	Waterbury, Vt.	Jan. 24
Feb. 13.	Dredging, etc.,	Cleveland, O.	Jan. 24
Feb. 12.	Church,	Deerfield, Mich.	Feb. 7
Feb. 12.	Railway in Arkansas (50 miles)		Feb. 7
Feb. 13.	Bridge substructure,	Rochester, N. Y.	Feb. 7
Feb. 13.	Stone road,	Mount Holly, N. J.	Feb. 7
Feb. 13.	Sewers,	Cleveland, O.	Feb. 7
Feb. 13.	Cast iron pipe,	Chicago, Ill.	Feb. 7
Feb. 14.	Pub. bldg. work at	New Berne, N. C.	Jan. 17
	Advertised, Eng. News, Jan. 17 and 24.		
Feb. 15.	Stone dam,	Holyoke, Mass.	Dec. 13
	Advertised, Eng. News, Dec. 13 to Jan. 24.		
Feb. 15.	Market house,	Cincinnati, O.	Jan. 24
Feb. 15.	Electric wiring,	Lafayette, Ind.	Jan. 31
Feb. 15.	Sewers,	Sheboygan, Wis.	Feb. 7
Feb. 16.	Sewers,	Cincinnati, O.	Jan. 24
Feb. 18.	Removing boulders,	Portland, Me.	Jan. 24
	Advertised, Eng. News, Jan. 24 to Feb. 14.		
Feb. 18.	Stone,	Portland, Me.	Jan. 24
	Advertised, Eng. News, Jan. 24 to Feb. 14.		
Feb. 18.	Dredging,	Norfolk, Va.	Jan. 24
Feb. 18.	Removal of ledge,	Portland, Me.	Jan. 24
	Advertised, Eng. News, Jan. 24 to Feb. 14.		
Feb. 18.	Brick court-house,	Rock Island, Ill.	Feb. 7
Feb. 18.	Brick paving,	Ottumwa, Ia.	Feb. 7
Feb. 19.	Torpedo boats,	Washington, D. C.	Dec. 6
Feb. 19.	Hydraulic elevators,	Washington, D. C.	Jan. 24
Feb. 19.	Plumbing at	New York, N. Y.	Jan. 31
	Advertised, Eng. News, Jan. 31 and Feb. 7.		
Feb. 19.	36-in. wooden stave pipe line,	Dallas, Tex.	Jan. 31
	Advertised, Eng. News, Jan. 31 to Feb. 14.		
Feb. 19.	Addition to U. S. print's house,	Wash'n.	Jan. 31
Feb. 19.	Pumping engine,	Oil City, Pa.	Jan. 31
Feb. 19.	Boilers,	Buffalo, N. Y.	Feb. 7
Feb. 19.	School building,	Bayonne, N. J.	Feb. 7
Feb. 19.	Hospital,	Sandusky, O.	Feb. 7
Feb. 20.	Water bonds ($25,000),	Kamloops, B. C.	Jan. 10
Feb. 20.	Metal work,	Portland, Ore.	Jan. 17
	Advertised, Eng. News, Jan. 17.		
Feb. 20.	Asphalt paving,	Ottawa, Ont.	Jan. 17
Feb. 20.	Breaking rock,	New York, N. Y.	Jan. 24
	Advertised, Eng. News, Jan. 24 to Feb. 14.		
Feb. 20.	Snagboat,	St. Louis, Mo.	Jan. 24
	Advertised, Eng. News, Jan. 24 to Feb. 7.		
Feb. 20.	Clearing reservoir site,	New York	Feb. 7
Feb. 20.	Steam pumps,	St. Louis, Mo.	Feb. 7
	Advertised, Eng. News, Feb. 7 and 14.		
Feb. 23.	Pipe sewers,	Elizabeth, N. J.	Feb. 7
Feb. 25.	Macadamizing,	Stapleton, N. Y.	Feb. 7
Feb. 25.	Iron bridge,	Cincinnati, O.	Feb. 7
Feb. 25.	Court-house bonds,	Waxahachie, Tex.	Feb. 7
Feb. 25.	Filling ravine,	San Francisco, Cal.	Feb. 7
Feb. 26.	Jail,	Beaumont, Tex.	Jan. 31
Feb. 26.	Plans for 2 school bldgs.,	Milwaukee	Feb. 7
Feb. 26.	Court-house,	Sparta, Wis.	Feb. 7
Feb. 26.	Flooring, etc.,	Worcester, Mass.	Feb. 7
	Advertised, Eng. News, Feb. 7 and 14.		
Feb. 27.	Removing dredge,	New York, N. Y.	Feb. 7
Feb. 27.	Sewers,	Cleveland, O.	Feb. 7
Feb. 28.	Breakwater repairs,	Duluth, Minn.	Jan. 24
Feb. 28.	Brick paving (5,700 sq. yds.),	Easton, Pa.	Feb. 7
	Advertised, Eng. News, Feb. 7 to 21.		
Feb. 28.	Electric lighting,	Urbana, O.	Feb. 7
Feb. 28.	Cedar blocks,	Fort Wayne, Ind.	Feb. 7
Feb. 28.	Stone, cement, etc.,	Duluth, Minn.	Feb. 7
Feb. 28.	Water-wks. system,	Port Clinton, O.	Feb. 7
	Advertised, Eng. News, Feb. 7.		
Mar. 1.	Electrical subways,	Baltimore, Md.	Feb. 7
Mar. 1.	Removing shoals,	Detroit, Mich.	Feb. 7
Mar. 2.	Pump and boilers,	Willimantic, Conn.	Feb. 7
	Advertised, Eng. News, Jan. 31 and Feb. 7.		
Mar. 6.	Water-wks. system,	Ashland, O.	Feb. 7
	Advertised, Eng. News, Feb. 7 to 21.		
Mar. 6.	Pile bridges,	Plattsmouth, Neb.	Feb. 7
Mar. 7.	Plans for school bldg.,	Milwaukee, Wis.	Feb. 7
Mar. 11.	Water-wks. system,	Knoxville, Ill.	Feb. 7
	Advertised, Eng. News, Feb. 7 to March 7.		
Mar. 27.	Plans for school bldg.,	Milwaukee, Wis.	Feb. 7
May 15.	Plans, etc., for bridge,	Montreal	Jan. 24
	Advertised, Eng. News, Jan. 24 and 31.		

RAILWAYS.

East of Chicago.

BENVENUE GRANITE QUARRIES.—The contract for 8,650 ft. of railway grading at these quarries, at Middletown, Conn., has been awarded to the Woodbridge & Turner Engineering Co., 41 Park Row, New York., construction to be commenced Feb. 5 and finished April 15. A. L. A. Himmelwright, Engr.

BOSTON & MAINE.—It is stated that plans are in preparation for laying new rails and reballasting the Eastern division from Boston to Portsmouth. The rails will be of a heavier pattern than those now in use. The work will commence early in the spring, or as soon as the rails can be secured.

BROADALBIN & ANTHONY'S CROSSING.—Mr. Cleveland, of Broadalbin, N. Y., is reported to have completed a preliminary survey for this proposed railway.

LUDINGTON & EPWORTH.—Press reports from Ludington, Mich., state that a local company is being organize to build a railway between that city and the Epworth resort grounds, north of the city. A portion of the stock has been subscribed and the line will be built early in the spring.

NEW YORK, SUSQUEHANNA & WESTERN.—A report is current to the effect that the New York, Susquehanna & Western R. R., of which the Wilkes Barre & Eastern is a part, is to be extended from Wilkes Barre to Orangeville to connect with the Wilkes Barre & Western, and at Watsontown connection will be made with the Central Pennsylvania & Western, which runs to Millhall, near Bellefonte. The New York, Susquehanna & Western owns controlling interests in these roads. A construction company has been formed to build between Wilkes Barre and Orangeville. A charter was obtained several years ago. The extension would also give a direct western outlet by way of Williamsport, and an outlet to Philadelphia as well, as the Reading connects with the Central Pennsylvania road.

PENNSYLVANIA.—Press reports from Johnstown, Pa., state that this company has been at work for some time purchasing right of way through that city for a branch line into the Somerset county coal fields, the construction of which will be commenced about March 1.—About 100 men, in charge of Engineer Mickey, of Wall, are at work on an extension of the West Penn branch from Bolivar to Sang Hollow, a distance of 15 miles, according to reports. One track is being laid and a township road is being made alongside the line

PITTSBURG, CHAUTAUQUA & LAKE ERIE.—The proposed railway from Warren, Pa., to Lake Erie is to be organized under this name. The "Railroad Gazette" states that it is to be built from Warren, Pa., to Westfield and Barcelona, N. Y., on the shores of Lake Erie, one of the best harbors on Lake Erie. The road will be about 50 miles in length and will extend through Chandlers Valley, Sugar Grove, North Warren and Lottsville, Pa., and Grant, Panama, Stedman, Chautauqua, Mayville and Westfield, N. Y. The president of the company is T. T. Keckeler, Philadelphia, and D. F. A. Wheelock, Warren, Pa., is chief engineer. The survey has been made, and the grades and curves will be easy and cost of construction light. The road will be through a rich agricultural and manufacturing locality, and if built will make the shortest line for travel from the east and south to Chautauqua and to the lakes, and a short line for coal to the lakes. The president is negotiating with parties for building the line this season, but as yet is not ready to state a time for letting the contract.

Southern.

CAROLINA MIDLAND.—Efforts are being made to secure an extension of this railway. Supt., J. C. Keys, Charleston, S. C.

HINTON & NEW RIVER.—The construction of this railway has been commenced, according to press reports. The road will extend from Hinton, W. Va., up the valley 32 miles to a connection with the Chesapeake & Ohio and the Norfolk & Western. Ch. Engr., R. H. Kello, Radford, Va.

LUMBER ROAD.—L. A. Davis & Bros. have purchased 40,000 acres of timber land near Crandall, Fla., and are reported about to build a railway from Crandall across the South Bend, a distance of about 12 miles.

POINT PLEASANT, BUCKHANNON & TYGARTS VALLEY.—It is hoped to complete this railway in this year and next. Ch. Engr., L. A. Mullins, Buckhannon, W. Va.

TENNESSEE.—Parties who can raise $1,000,000 to construct and equip 150 miles of railway are asked to correspond with Chas. A. Barton, 16 Madison St., Memphis, Tenn., as stated in our advertising columns.

Northwest.

CHICAGO, PADUCAH & MEMPHIS.—This railway was completed into Mount Vernon, Ill., last week. Ch. Engr., F. P. Reed, St. Elmo, Ill.

DULUTH & NORTH DAKOTA.—D. W. Hines, of St. Thomas, N. Dak., is the chief projector of this railway. The company is composed wholly of farmers, who propose to build a railway from Thief River Falls, Minn., to Portal, N. Dak., at a cost of $2,000 per mile. The work will all be done by the farmers, and the towns interested bonded for enough to purchase second-hand rails and equipment. Press reports state that considerable assistance is being given the projectors and that a camp has been established and men are cutting ties for the road. J. A. Whitmore, I. E. Mussell, and John Cochran, of Drayton, N. Dak., are also interested.

ELGIN, JOLIET & EASTERN.—This company is reported as making surveys for proposed extensions to East Chicago and also to Whiting, Ind. A press report states that this would give about 90 miles of road and form the most complete belt line in the vicinity of Chicago.

MERRILL, ANTIGO & EASTERN.—Surveys are reported as having been commenced for this railway in Wisconsin.

Southwest.

LINK LINE.—Emzy Taylor, Pres., Georgetown, Tex., writes us that the Georgetown & Granger and the Trinity, Cameron & Western railway companies are now called the Link Line. Surveys have been made for 146 miles, right of way obtained and 15 miles graded from Georgetown to Granger. In the work done the grade was less than 1% and the curvature did not exceed 3°. There will be 11 large steel bridges and some heavy grading. M. P. Kelley & Co., of Georgetown, have the contract for building the road. Tracklaying will be commenced about March 1, the line opened for traffic May 1, 1895, and the entire road completed Sept. 1, 1896. Application has been made for a new charter and it is intended to extend to Austin and to Granite Mountain and also from Trinity to Sabine Pass. Ch. Engr., Jno. O'Neill, Georgetown, Tex.

NORTHERN.—Incorporated in Oklahoma, Feb. 1, to build a railway from Arkansas City or Hunnewell, Kan., to Blackwell, Okla.; capital stock, $100,000; Pres., A. J. Blackwell; Vice-Pres., J. C. Miller; Secy., John R. May; Treas., F. W. Potts; principal office, Blackwell, Okla.

SPRINGFIELD, HARRISON & LITTLE ROCK.—Incorporated in Missouri, Jan. 29, to build a railway from Springfield in a southerly direction to the southern boundary line of the state of Missouri, in the county of Stone or Taney, in the direction of Little Rock, Ark., a distance of about 90 miles; capital stock, $700,000; incorporators, J. Knowlton Jones and Thomas A. Scott, of St. Louis; W. T. Atkinson, of Philadelphia; F. B. Rogers of St. Louis, and Robt. H. Laird, of London, Ont.

TEXARKANA & FORT SMITH.—Monroe, Strang, Lee & Co., 15 Wall St., New York, will award contracts at Texarkana, Ark., on and after Feb. 12 for 50 miles of heavy work, including grading, bridging and masonry, on this road.

Rocky Mt. & Pacific.

COLUMBIA RIVER & RED MOUNTAIN.—Incorporated in Washington by D. C. Corbin, of New York; Austin Corbin, Jr., Frank George and Albert Allen, of Spokane. This is the proposed extension of the Spokane & Northern to the Trail Creek mines of British Columbia. Mr. Corbin is now applying for a charter before the Victoria legislature, and it is believed that he will be successful and that the road will be built this year.

SAN FRANCISCO & SAN JOAQUIN.—Press reports state that nearly $1,500,000 has been subscribed in aid of this proposed railway from San Francisco to Stockton and down the San Joaquin Valley to Bakersfield and Mojave, on the Atlantic & Pacific. Claus Spreckles has subscribed $500,000 for himself and $100,000 each for two sons. It is expected that the construction will soon be commenced. E. F. Preston, Alex. Boyd, J. D. Phelan, and J. L. Flood are among those interested.

STREET AND ELECTRIC RAILWAYS.

AUGUSTA, ME.—A bill has been introduced into the legislature to incorporate the Wells Beach & Ogunquit Electric R. R. Co.

SKOWHEGAN, ME.—Subscriptions to aid in the construction of the Madison & Athens Electric Ry. are being secured on condition that $30,000 is subscribed.

FALL RIVER, MASS.—The Fall River & Providence St. Ry. Co. has petitioned for a charter for an electric railway; capital stock, $250,000; incorporators, Chas. F. Shaw, of New Bedford; Frank S. Stevens, of Swansea; Robt. T. Davis, and Gen. W. Slade, of Fall River.

HINGHAM, MASS.—The Hingham St. Ry. Co. has been incorporated to build an electric railway between Hingham and Hull, a distance of about 18 miles; capital stock, $45,000; Secy. and Treas., Walter B. Foster; directors, J. J. Moore, B. C. Wilder, Sidney Cushing and C. H. Marble.

NORTHAMPTON, MASS.—The Western Hampshire St. Ry. Co. has petitioned for a charter to build an electric railway from Williamsburg to Goshen, Cummington and Worthington, a distance of 20 miles; capital stock, $200,000. Lyman D. James, of Williamsburg; Alvan Barrus, of Goshen; J. C. Hammond, of Northampton, and John Olmstead, of Springfield, are interested.

PROVIDENCE, R. I.—The extension of the Elmwood and Auburn electric railway to the state prison at Howard from its present terminus, the Budlong farm, is being discussed.

HARTFORD, CONN.—The Winsted St. R. R. Co. has petitioned the legislature for a charter.

BALLSTON SPA, N. Y.—The Ballston Electric R. R. Co. has been incorporated to build a line from this place to Greenfield, a distance of 10 miles; capital stock, $200,000; the contract for building the line will be awarded this week, according to reports. Incorporators, Thomas Craig, of Trenton; C. E. W. Smith, of New York; F. R. Barnes, of Ballston Spa; J. A. Leggett, of Troy.

FRANKFORT, N. Y.—The Frankfort & Utica St. Ry. Co. has been incorporated to build an electric railway to be seven miles in length; capital stock, $70,000; Pres. and Treas., John V. Quackenbush, of Mohawk; Secy., Nelson J. Davis, of Utica; directors, Clinton Beckwith, of Herkimer; John Loftis, of Frankfort.

NEW YORK, N. Y.—The People's Traction Co. has been incorporated with a capital stock of $1,500,000, to build a street railway to be 20½ miles in length; directors, Franklin A. Wilcox, Edward H. Hobbs, J. Clarence Davis and J. A. Beusel, of New York; Martin J. Keough, of New Rochelle; Charles B. Hobbs, of Brooklyn; John Foley, Jr., of Seawarren, N. J.—The Manhattan Elevated R. R. Co. is reported as considering the building of cross-town connections and of equipping the entire system with electricity.

BELLEVILLE, N. J.—The Passaic & Newark Electric Ry. Co. has petitioned for a franchise.

CAMDEN, N. J.—The West Jersey Traction Co. has petitioned for an extension of its electric line in the northern part of the city.

ARLINGTON, N. J.—The township committee is considering the question of granting a franchise to the Union Traction Co., of Rutherford, which proposes to build an electric railway on the Belleville turnpike.

ATLANTIC CITY, N. J.—The Atlantic City St. Ry. Co. has petitioned for a franchise for its line on three streets. John J. Gardner is interested.

PLAINFIELD, N. J.—The Plainfield St. Ry. Co. has applied for permission to extend its electric line over about five miles of additional streets. It is reported that the company has already secured the right of way to Fanwood, Netherwood and Dunellen, a distance of about five miles.

POTTSVILLE, PA.—The Tamaqua & Pottsville Electric Ry. Co. is reported as having borrowed $250,000 with which to build its road.

SCRANTON, PA.—The North End & Franklin Ave. Ry. Co. and the North End Ry. Co. have petitioned for franchises.

STRASBURG, PA.—It is reported that $16,000 have been subscribed towards the construction of the Lancaster & Strasburg Electric Ry. C. W. Brenninger and E. C. Musselman are interested.

BALTIMORE, MD.—It is reported that the City & Suburban Ry. Co. will soon ask for bids for constructing seven miles of its electric line. The road will have a double track and 70 and 75-lb. steel rails will be used. Supt., J. E. Hayward.

BOONSBORO, MD.—It is stated that about $13,000 have been subscribed to aid in the completion of the South Mountain Electric Ry., from Boonsboro to Keedysville. A good deal of grading has been done, a power house built, and a number of poles put up, but on account of difficulties, the work was stopped about a year ago. It is estimated that $26,000 will be needed to complete the line. A. W. Lakin and S. S. Davis are on a committee appointed to secure a new charter.

WASHINGTON, D. C.—Press reports state that Mr. Catchings, of Mississippi, has introduced a bill in the House to incorporate the National Rapid Transit Ry. Co. The projectors of the enterprise want authority to construct an elevated electric railway between Washington, D. C., and New York city. If they are granted such authority, they propose to guarantee to maintain a line which will reduce the time between the two points more than one-half. The speed stipulated is 120 miles an hour.

COLUMBUS, N. C.—It is reported that a company has been formed to build an electric railway from Tryon to Columbus and Chimney Rock.

ATLANTA, GA.—The Dixie Intramural Ry. Co. has been formed to build an electric elevated railway, to be about 1½ miles in length, in the cotton states international exposition grounds. There will be about 12 cars. Pres., I. Y. Sage; Secy., T. H. Martin.

BOWLING GREEN, KY.—Press reports state that the people of this city are endeavoring to secure an electric railway. The mule system was abandoned several months ago on account of it not being a paying investment, and since that time Bowling Green has had no street railway service. Frank Halliday, of Ironton, O., is reported as saying that his company is willing to put in an electric system, to cost from $50,000 to $60,000, provided the citizens will make the necessary donation.

HARRODSBURG, KY.—The construction of an electric railway from Harrodsburg to Danville is contemplated. The cost of a line from Harrodsburg to Junction City is also being investigated, according to reports.

MONTICELLO, KY.—The construction of an electric railway between this place and Burnside is being discussed. F. H. Bagby, J. A. Brown and J. W. Tuttle have been appointed as a committee to secure information, etc.

CINCINNATI, O.—The Cincinnati Inclined Plane Ry. Co. is considering the question of extending its line around Mount Auburn, instead of constructing a new inclined line up the hill.

ELYRIA, O.—L. M. Coe, of Cleveland, has been granted a franchise in Rockport Hamlet for an electric railway to this place.

LORAIN, O.—The Lorain & Wellington Ry. Co. has been incorporated to build an electric railway between this city, Wellington, Amherst and Oberlin; capital stock, $100,000; incorporators, H. G. Redington, E. M. Pierce, John Stang, J. W. Steele and O. F. Carter.

SPRINGFIELD, O.—It is reported that Wm. A. McCorkle, Governor of West Virginia, is interested in a projected electric railway between this place and Urbana.

ELKHART, IND.—Press reports state that the Indiana Electric Ry. Co. has awarded a contract for the purchase of seven miles of steel rails for the completion of the line between this city and Goshen. The company has also purchased 25 acres of land near the county seat for the purpose of erecting a power house and station. Two miles of the road had been laid in this city when the cold weather prevented further work. The line will be pushed as soon as the season opens.

BAY CITY, MICH.—The Saginaw & Bay City Ry. Co. has been incorporated with a capital stock of $500,000 by Walter S. Eddy, W. Y. Soper and Thomas Ahearn.

ROYAL OAK, MICH.—The Oakland Ry. Co. has been incorporated with a capital stock of $50,000 by George Hendrie and John C. Donnelly.

CHICAGO, ILL.—The Cicero & Proviso St. Ry. Co. has increased its capital stock to $2,500,000.

PEORIA, ILL.—J. C. White is interested in a projected electric railway in this city, according to reports.

MARINETTE, WIS.—Press reports state that it is probable that two additional miles of street railway will be constructed in this city in a short time. The is said to represent the actual investments of the com- capital stock of the Gas, Electric Light & Ry. Co. is pany. The new line will run along the bay shore.

OSHKOSH, WIS.—The Central Wisconsin Electric Ry. Co. has been incorporated to build a line between Oshkosh, Neenah, Menasha and Kaukauna; capital stock, $1,000,000; it is thought that the line will be in operation by June 15. Pres., Geo. H. Ketcham, Toledo, O.; Vice-Pres., Geo. J. Kobush, St. Louis; Secy. and Treas., F. M. Ohl, Toledo, O.; directors, T. E. Ryan, Waukesha, Wis., and M. L. Campbell, Neenah, Wis. $100,000, which may be raised to $200,000, which figure James K. Tillotson, of Toledo, O., is interested. Contracts have been awarded as follows: Rankin & Fritch, for building the power house; the St. Louis Car Co., for furnishing the cars, and C. E. Loss & Co., Chicago, for building the road.

SIOUX CITY, IA.—The Sioux City Rapid Transit Ry. is to be sold on Feb. 23. The line is operated by electricity and is six miles in length. Supt., W. Miller.

ST. LOUIS, MO.—It is reported that the Lindell Ry. Co. will, in a few days, award the contract for building 30 cars, 34 ft. in length. This will make the second order within two months, and calls for an equipment of 60 cars in all.—The St. Louis & Jefferson Barracks Ry. Co. has been incorporated at Clayton with a capital stock of $30,000.

ELECTRIC LIGHT AND POWER.

HILLSBORO BRIDGE, N. H.—It is reported that a syndicate is soon to put in an electric light plant, the power for which will be transmitted from a point two miles below the village.

MARYSVILLE, PA.—The electric light question is being discussed and A. J. Seidle is reported as desiring the contract.

NEWPORT, PA.—A correspondent writes us that an ordinance has been passed for electric lighting.

PHILADELPHIA, PA.—Plans have been nearly completed for an electric light plant for the city hall. At present there is a small plant in the basement, containing three dynamos, but it is scarcely one-tenth sufficient for the entire structure. The new plant will occupy a large portion of the courtyard, and will cost between $250,000 and $300,000, according to reports.

FLORENCE, ALA.—G. W. Swartz is reported as interested in a project to utilize the water power of the Cypress Creek for generating electricity for running the manufacturing plants at this place, and it is reported that arrangements are now being made for the construction.

PALATKA, FLA.—The citizens have voted to award a contract to the Palatka Light & Fuel Co. for electric lighting.

COLUMBUS, MISS.—It is reported that the construction of a municipal electric light plant is being discussed. E. C. Chapman is interested.

OWENSBORO, KY.—It is reported that the engineer engaged to make a report for a municipal electric light plant estimates that arc lights will cost $50 per year each.

URBANA, O.—Bids are asked until Feb. 28 for lighting the city with 95 electric lights of 2,000 c. p. for five years. W. E. Berry, Cy. Clk.

ELKHART, IND.—Press reports state that it is proposed to utilize the water power of the St. Joseph River by erecting a plant a few miles north of South Bend, from which power can be supplied to Elkhart and other neighboring cities for operating street railways and electric lights.

CHICAGO, ILL.—The Woodlawn Electric Light, Heat & Power Co., in which Guy Owings is interested, and the Consumers' Electric Light Co. have petitioned for franchises.

ROCK FALLS, ILL.—The citizens are discussing the subject of an electric light plant.

MILWAUKEE, WIS.—The Western Electric Co., of Chicago, has been awarded a contract for wiring the new city hall for electricity. There were two other bids.

WEYAUWEGA, WIS.—The citizens have voted to award a contract for electric lighting. Weed, Gumaer & Co. have offered to furnish arc lights at $45 per year each. It is probable this proposition will be accepted

RICHMOND, MO.—The Richmond Electric Light Co. has been granted a franchise.

WELLS, MINN.—The following bids have been received for an electric light plant: O. H. Olsen & Co., Stillwater, Minn., $5,814; S. A. Jones, Madison, S. Dak., $5,634; Siemens & Halske, St. Paul, Minn., $6,065; Fort Wayne Electric Co., Minneapolis, $6,372; all for alternating current plants; Clausen & Bonwell, St. Paul, $7,072, for Edison 3-wire plant; and Siemens & Halske Co., St. Paul, $6,981; Western Electric Co., $7,200, and Clausen & Bonwell, St. Paul, $6,936, all direct current connected 220-volt plants. Contract awarded to last-named for General Electric Co.'s materials throughout. Engr., Chas. F. Loweth, 94 East Fourth St., St. Paul.

CENTRALIA, WASH.—It is reported that this place will soon vote on a proposition to issue bonds for an electric light plant.

OAKLAND, CAL.—F. A. Ross is reported as interested in a company which proposes to transmit electricity from Folsom to Sacramento, a distance of 23 miles. The water for furnishing the power will be secured from the American River. A large stone dam has been built during the last six years at Folsom by convict labor, which will store enough water to furnish electric power for street railways, manufacturing purposes and lighting the city. The company will also furnish power to the Central Pacific R. R. shops, which are located in Sacramento, and to many other institutions.

NEW COMPANIES.—Cascade Electric Light & Power Co., Berlin, N. H.; $15,000.

Clintonville Electric Light & Power Co., Clintonville, Wis.; $8,000; D. S. Stewart.

York Light & Power Co., York, Neb.; $12,000; S. N. Sedgwick, Geo. R. Reed, A. C. Montgomery, H. C. Page.

Commercial Heat & Power Co., Chicago, Ill.; $2,000,000; Daniel V. Harkin, Henry G. Colsen, M. W. Cagney.

Clear Creek Gold Mining & Water Power Co., Denver, Colo.; $1,000,000; Henry Lewis, H. J. Hayham, W. G. Smith.

Seneca Light & Power Co., Seneca Falls, N. Y.; $100,000; A. C. Mercer, C. T. Silsby, Seneca Falls; P. M. Kendig, Waterloo.

Harrison Electric Co., Chicago, Ill.; $500,000; to manufacture electrical machinery; Edward M. Harrison, Lewis H. Painter.

Newton Light & Power Co., Newton, Kan.; $50,000, with $5,000 paid in; Lewis B. Gawter, New York, N. Y.; Julius A. Bailey, Philadelphia, Pa.; John C. Nicholson, Robert Dougherty, Newton.

BRIDGES.

BOSTON, MASS.—The city architect has been requested to submit estimates for a bridge over Court Square, to connect the city hall with the old court-house.

HAVERHILL, MASS.—The legislative committee on bridges will give a hearing Feb. 8 to parties interested in the petition of the selectmen of West Newbury, Amesbury and others for the reconstruction of a part of Rocks Creek bridge over the Merrimack River near this city.

BUFFALO, N. Y.—By a vote of 7 to 3 the House commerce committee has laid on the table the bill providing for a bridge across the Niagara River at Grand Island. This disposes of the bill for the present Congress.

CARTHAGE, N. Y.—Geo. W. Aldrich, Supt. Pub. Wks., has reported to the state senate that the bridge at West Carthage is unsafe and should be replaced by a new bridge.

CAYUGA, N. Y.—A bill has been introduced in the assembly appropriating $1,000 for surveys for a bridge at the outlet of Cayuga Lake between Cayuga and Seneca counties.

MAMARONECK, N. Y.—The town boards of this place and Rye are considering the replacing of the present wooden bridge connecting the two towns by a stone structure.

LONG ISLAND CITY, N. Y.—The Queens county board of supervisors has voted to direct the joint bridge committee of Kings and Queens counties to advertise for bids for constructing a lift bridge over Newtown Creek, connecting Greenpoint and Hunter's Point. The bridge will be about 145 ft. high and is estimated to cost $250,000.

PEEKSKILL, N. Y.—A bill has been introduced into the legislature granting the Peekskill State Camp & Mohegan R. R. Co. permission to build a draw-bridge across Annsville Creek from the Murdock property to the state camp.

PORT DICKINSON, N. Y.—The construction of a bridge across the Chenango River, at an estimated cost of $15,000, is being discussed.

ROCHESTER, N. Y.—Bids are asked until Feb. 13 for constructing the substructure for a lift-bridge over the Erie Canal at Emerson St., Geo. W. Aldridge, Supt. Pub. Wks., Albany.

SCHUYLERVILLE, N. Y.—Press reports state that an iron bridge will soon be built across the Hudson River at Schuylerville for the American Wood Board Co. Pres., Isaac C. Blandy. The bridge will consist of three riveted lattice spans, each 143 ft. long, with a roadway of 16 ft. The structure was designed by Geo. S. Groesbeck, Engr., for the R. F. Hawkins Iron Works, Springfield, Mass., to which the contract has been given.

PITTSBURG, PA.—Plans have been prepared for a bridge at the Forbes St. entrance to Schenley Park.

BALTIMORE, MD.—W. C. Hall writes us that the Baltimore & Catonsville Construction Co., which will build the Baltimore end of the Boulevard electric railway, is negotiating with the Baltimore & Potomac R. R. Co. to obtain a crossing under its tracks at Franklin St., in Baltimore. There will be considerable masonry and a five-track girder bridge. Pres., B. N. Baker.

WASHINGTON, D. C.—An amendment to the district appropriation bill has been presented appropriating $5,000 for a survey for a bridge across the Eastern Branch at the foot of South Capitol St. This question has been before Congress for several sessions.——A bill is being considered for the construction of a memorial bridge across the Potomac to Arlington. The bridge is to cost $600,000 and tramways of all kinds are prohibited from using the bridge. Only $100,000 is appropriated for immediate use.

MOUNTAIN LAKE PARK, MD.—It is reported that a bridge will be built across Broad Ford Run to Crystal Spring drive, to connect it with the lake drive.

LINDEN, TENN.—Perry county has been authorized to issue bonds for bridges.

AKRON, O.—Plans have been accepted for the Park St. steel bridge, which is to be 200 ft. long and 50 ft. in width. The contract will be awarded as soon as possible. The railway companies will pay for constructing the bridge.

CINCINNATI, O.—Bids are asked until Feb. 25 for building an iron Pratt truss bridge over Little Duck Creek in Columbian township, Hamilton county. Geo. C. Zimmerman, Clk. County Comrs.

TOLEDO, O.—The contract for the bridge over Swan Creek at Perry St. was awarded, Feb. 2, to the Toledo Bridge Co., for its lift bridge, plan No. 4, at $32,000. The matter of the construction of a new bridge across the Maumee River is awaiting he approval of the War Department, all other legislation having been completed. Lem. P. Harris, Cy. Clk.

CHICAGO, ILL.—The city engineer has reported in favor of constructing several bridges at an estimated cost of about $1,000,000.

DAVENPORT, IA.—E. W. Boynton, Comr. Pub. Wks., has prepared the following estimates for the proposed bridge noted in our issue of Jan. 24:

440 tons 70-lb. steel rail, at $25	$11,000
1,408 joints, at $2.50	3,520
Three miles embankment, 10 ft. high; 170,000 cu. yds., at 25 cts.	42,500
Iron work, 5,760,000 lbs., at 4 cts.	230,400
Masonry, 10,500 yds., at $20	210,000
Four miles tracklaying, at $500	2,000
Right of way	30,000
Freight depot	5,000
Total cost	$534,420

SIOUX CITY, IA.—The Iowa & Nebraska Pontoon Bridge Co. has applied to Congress for permission to construct a steel drawbridge across the Missouri River at this place, at an estimated cost of $50,000. Pres. and Gen. Man., R. A. Talbot; incorporators, Joseph Giesler, J. P. Twohig, W. H. Ryan and M. L. Flinn.

PORT HURON, MICH.—The following bids were received for a steel swing bridge across Black River in this city. The bids were on a 160-ft. swing span, with 18 ft. clear roadway and 6 ft. sidewalks, 220 ft. of steel trustle approaches, with substructure complete; Cy. Engr., F. F. Rogers:

Variety Iron Wks., Cleveland	$14,727 and $17,527
Chicago Bridge & Iron Co., Cleveland	17,680
Michigan Bridge Co., Portland, Mich.	17,826
Iron Substructure Co., Columbus, O.	18,780
R. D. Wheaton Bridge Co., Chicago	19,990
Penn Bridge Co., Beaver Falls, Pa.	20,000
Detroit Bridge & Iron Wks (8 bids)	$20,012 to 23,250
Wisconsin Bridge Co., Milwaukee	$20,520 and 21,350
Massillon Bridge Co., Massillon, O.	$21,500 and 22,000
Toledo Bridge Co., Toledo, O.	21,679
Ohio Bride Co., Toledo, O.	22,000
Groton Bridge Co., Groton, N. Y.	22,222
Champion Bridge Co., Wilmington, O.	22,275
King Bridge Co., Celeveland	$22,359 and 22,810
Wrought Iron Bridge Co., Canton, O.	22,500
R. Dunn & Co., Detroit, Mich.	23,270
Milwaukee Bridge Co., Milwaukee, Wis.	24,252
New Jersey Steel & Iron Co., Trenton, N. J.	24,608

PORTLAND, MICH.—The Michigan Bridge Co. has been incorporated with a capital stock of $10,000.

OTTAWA, KAN.—A bill has been introduced authorizing the commissioners of Franklin county to appropriate money for a bridge across Marais des Cygnes River.

PLATTSMOUTH, NEB.—Bids are asked until March 6 for the construction of pile bridges during 1895. Frank Dickson, County Clk.

ST. LOUIS, MO.—The council has passed ordinances authorizing two iron bridges on Main St.

ST. LOUIS, MO.—The board of directors of the merchants' exchange has appointed W. G. Boyd, E. O. Standard and Geo. E. Leighton a committee to urge that the bill now being considered for a bridge across the Mississippi River at St. Louis be amended so as to provide that if a bridge is erected between the Eads Bridge and the Merchants' Bridge it shall be a suspension bridge, or in lieu of this, that if it is to be a pier bridge it shall not be located within a distance of two miles above or below the Eads Bridge. Efforts are being made to secure the early construction of the proposed new bridge.

EL RENO, OKLA.—The El Reno Bridge Co. has been authorized to construct a bridge over the South Canadian River.

LOS ANGELES, CAL.—The council is considering an ordinance for a bridge over Pasadena Boulevard near the old Lacy carpet cleaning mill.

BUILDINGS.

WORCESTER, MASS.—Bids are asked until Feb. 26 for the brick and terra cotta floor and ceiling arches, concrete filling, terra cotta firring etc., for the U. S. post office building in this city, as stated in our advertising columns. Address Chas. E. Kemper, Acting Supervising Architect, Washington, D. C.

BUFFALO, N. Y.—Frederick Mohr, Arch., is preparing plans for a $70,000 addition to the penitentiary. It will be three stories high and will contain about 300 cells.——The aldermen voted Feb. 4 to request the Legislature to pass a bill providing that the old Prospect reservoir site be deeded to the state, and that the present building and site of the 74th Regiment Armory be deeded to the city, in order that a new armory may be built on the reservoir site. The corporation counsel was directed to draft the bill with the condition that the state shall appropriate not less than $400,000 for the construction of the armory within two years from Jan. 1, 1895.——A transfer elevator with a capacity of 200,000 bushels is projected at East Buffalo. Charles Kennedy of the Merchants' Exchange and others are interested.——The German-American Brewing Co. has instructed August Esenwein, Arch., to prepare plans for a 3-story brick building, 70 x 170 ft., on the south west corner of Main and High Sts. It will cost about $40,000.

NEW YORK, N. Y.—Richard W. Hawke has been granted a permit to construct seven five-story brick flats on 123d St., estimated to cost $168,000.——H. O. Havemeyer is reported as to commence the construction of a 20-story office building on the site of the old "Herald" building, as soon as possible after the present lease expires May 1.

TONAWANDA, N. Y.—It is expected that the state will purchase a site for an armory Feb. 15, and on April 1 advertise for bids for its construction. The appropriation for the building is $32,000.

BAYONNE, N. J.—Bids are asked until Feb. 19 for reconstructing a school building, estimated to cost $27,000. W. C. Hamilton, Cy. Clk.

WASHINGTON, D. C.—The following bids were received Jan. 31 for the iron and steel work for the post office building in this city, as advertised in Engineering News Jan. 10:

Wrought Iron Bridge Co., Canton, O.	$77,908
Edge Moor Bridge Co., Wilmington, Del.	73,519
John Pierce, New York, N. Y.	75,500
Benner & Opdyke, Philadelphia, Pa.	84,767
Benjamin Hyde, Chicago, Ill.	71,980
Thorp & Bond, New York, N. Y.	67,498
L. Schrieber & Sons Co., Cincinnati, O.	77,000
Fred. J. Meyers Mfg. Co., Hamilton, O.	82,990
Pennsylvania Steel Co., Philadelphia, Pa.	71,430
New Jersey Steel & Iron Co., Trenton, N. J.	83,360
Campbell & Zell, Baltimore, Md.	79,678

SANDUSKY, O.—Bids are asked until Feb. 19 for the erection of a hospital for the Ohio soldiers' home. Arch., H. C. Lindsay, Zanesville; W. P. Orr, Pres. Bd. Trustees.

TOLEDO, O.—The Toledo Consolidated St. Ry. Co. is to build a new barn in the spring, to accommodate 75 cars, estimated to cost about $10,000.

ROCHESTER, IND.—A. W. Rush & Son, Archs., Grand Rapids, Mich., have prepared plans for a brick court-house, estimated to cost $70,000. The contract will be awarded about March 15, according to reports.

DEERFIELD, MICH.—Bids are asked until Feb. 12 for the erection of a church. T. E. Sweeny, Secy. Com., Parshallville.

ROCK ISLAND, ILL.—Bids are asked until Feb. 18 for the erection of a brick or stone court-house on a lot 320 x 320 ft., estimated to cost about $110,000. W. P. Quayle, Chn. Bd. of Supervisors.

MILWAUKEE, WIS.—Bids are asked by the board of public works until Feb. 26 for plans for additions to two school buildings, cost not to exceed $12,000 and $30,000, respectively; and until March 7 for plans for a school building to cost $45,000, and until March 27 for plans for one to cost $80,000.

SPARTA, WIS.—Bids are asked until Feb. 26 for the construction of the Monroe county court-house. Arch., M. E. Bell, Chicago; N. W. Huntley, Chn. Bldg. Com.

ST. LOUIS, MO.—Bids are asked until Feb. 11 for the erection of eight new school buildings. L. J. Holthaus, Chn. Bldg. Com., Bd. Pub Schools.

WAXAHACHIE, TEX.—Bids are asked until Feb. 25 for the purchase of $100,000 or $150,000 of 5% bonds for the Ellis county court-house. J. C. Smith, County Judge.

DENISON, TEX.—Press reports state that orders have been received in this city instructing Missouri, Kansas & Texas Ry. officials to prepare for the construction of the new roundhouse. The structure will be of brick, and will contain 40 stalls. The sum of $75,000 has been appropriated to cover the cost.

WINDSOR, ONT.—A committee has been appointed by the aldermen to confer with the county council with reference to the construction of the proposed combination city and county building, estimated to cost about $50,000.

WATER WORKS.

NORTH BERWICK, ME.—The North Berwick Water Co. has applied for a charter.

UNION, ME.—Fred A. Alden, B. Burton, O. A. Burkett and others have petitioned for a charter for the Union Water Co.; capital stock, $10,000; proposed supply from a reservoir about a mile from the village.

WINTERPORT, ME.—C. R. Hill, Town Clk., writes us that the Winterport Water Co. has secured a charter, as noted last week, but that the prospects for immediate action are not good.

YORK, ME.—Josiah Chase, R. M. Webb, W. H. Howard and others have petitioned for a charter for the York Shore Water Co. to supply Wells and York; capital stock, $400,000.

MANCHESTER, N. H.—Plans have been prepared for a new fire main, estimated to cost about $100,000.

ATHOL, MASS.—A committee is negotiating for the purchase of the works by the town.

MONTAGUE, MASS.—E. F. Harrington writes us that the petition for permission to organize a water supply district has been sent to the legislature.

PEPPERELL, MASS.—The board of trade is investigating the question of works, to report March 5.

VINEYARD HAVEN, MASS.—The citizens are considering the question of purchasing the works.

WENHAM, MASS.—W. F. Trowt and others have petitioned that this town be authorized to put in works.

WOONSOCKET, R. I.—The senate has passed a bill authorizing this city to issue $100,000 in bonds for the extension of the water-works.

SEYMOUR, CONN.—Geo. A. Fernald & Co., of Boston, are interested in proposed works at this place.

SUFFIELD, CONN.—The Village Water Co. has petitioned for a charter.

WILLIMANTIC, CONN.—Bids are asked until March 2 for a 2,000,000-gallon steam pump, as stated in our advertising columns. This is a postponement from Feb. 15, as noted last week. Walter D. Brigham, Chn. Com.

KINDERHOOK, N. Y.—Press reports state that a meeting of the tax-payers will soon be held to consider the question of proposed works. W. H. Rainey, Chn. Com; W. A. Rorabock, Clk.

BUFFALO, N. Y.—Bids are asked until Feb 19 for four boilers; R. G. Parsons, Secy. Dept. Pub. Wks.——The water department has reported that the condition of the supply needs immediate and serious attention. The capacity of the pumps should be increased, and it is recommended that meters be placed wherever water is wasted.

COLLEGE POINT, N. Y.—The village trustees voted Feb. 4 to erect a water tower at a cost of $18,000, according to a press report.

DANSVILLE, N. Y.—The tax-payers are reported about to vote on the question of selling the works to a private company.

FREDONIA, N. Y.—C. A. Clute, Cy. Clk., writes us that E. A. Wilder, of Fredonia, is preparing plans and estimates for an increased supply.

LANCASTER, N. Y.—Plans and specifications for works have been completed and approved by the board of trustees, according to reports.

LEROY, N. Y.—The proposition to appropriate $1,500

for additional investigations for a supply was defeated Jan. 29 by six votes. It is claimed that this election was merely to get the sentiment of the citizens and that the trustees have authority to appropriate $2,000 if necessary. The water contract expires in July.

MIDDLETOWN, N. Y.—An election will be held Feb. 12 to vote on the adoption of the plans prepared by J. J. R. Croes, of New York, for the enlargement and improvement of the works.

NEW YORK, N. Y.—Bids are asked by the aqueduct commissioners until Feb. 20 for cutting timber and clearing grounds for reservoir D, near Carmel.

YONKERS, N. Y.—The commissioners have voted in favor of issuing $300,000 in bonds for extensions.—— Jos. A. Lockwood, Supt., writes us that the work for 1895 will consist of completing the new reservoir and ordinary extensions and probably the putting in of two new boilers.

CAMDEN, N. J.—It is reported that the committee investigating the question of a new supply will recommend the erection of a new reservoir and pumping station at Bethel.

MEDFORD, N. J.—H. L. Knight, Cy. Clk., writes us that the proposed works will require a pump standpipe and meters, though nothing definite has been decided yet; supply from stream; population, 1,500; Engr., W. B. Cooper, Medford; Chn. Com., I. W. Garwood.

WEST ORANGE, N. J.—The legislature has passed a bill authorizing this town to issue bonds for the purchase of works.

WILDWOOD, N. J.—It is reported that plans are being made for works which the Baker Bros. propose erecting at the new artesian well.

BENTON, PA.—H. H. Hulme, Engr., writes us that it is expected that the town will be incorporated in May, and that no works can be put in until after that time.

CATASAUQUA, PA.—The Crane Iron Co. has offered to sell its works to the borough for $50,000.

ERIE, PA.—The proposed extension of the intake into the lake will soon be reported on by Rudolph Hering and Walter C. Brough, who have examined the plans and specifications. It is reported probable that about $100,000 worth of work will be done this year.

HARRISBURG, PA.—Robert E. Wright, of Allentown, is said to be at the head of the company that proposes to secure a supply for this city from Boiling Springs.

HOMESTEAD, PA.—The bids for a pumping engine have been rejected, and Elmer Hough, Borough Engr., writes us that new bids will probably be received for a 2,500,000 or a 3,000,000-gallon pump, to work under 314 ft. head, through 6,200 ft. of 14-in. main.

MARYSVILLE, PA.—It is reported that the citizens contemplate the construction of works.

NEW CASTLE, PA.—It is stated that the contract for pipe for a 16-in. main will soon be awarded.

BLOOMVILLE, DEL.—It is stated that H. C. Soop, F. M. Andrus, F. D. Dewey and others are organizing a company to put in works for which a franchise will be granted.

HICKORY, N. C.—There is talk of constructing works, according to reports.

GUYTON, GA.—Efforts are being made to raise funds for an artesian well.

KEY WEST, FLA.—A correspondent writes us that the construction of works was commenced Jan. 29 by the Virginia Paving & Construction Co., of Lynchburg, Va., the contractors; the boring of an artesian well was commenced at 11 a. m. and at 6 p. m. a depth of 32 ft. had been attained; the work will be rapidly pushed. M. F. Cahill will supervise the laying of the mains. The work will include 8 miles of mains, an artesian well, a 20 × 75-ft. stand-pipe, two 1,250,000-gallon duplex pumping engines and 53 fire hydrants. The Glamorgan Pipe & Foundry Co., Lynchburg, Va., will furnish the pipe and stand-pipe and the Kennedy Valve Co. the hydrants and valves.

MARION, ALA.—The city has petitioned for authority to issue $30,000 in bonds for works.

MOBILE, ALA.—The bill authorizing the city to build new works has been introduced in the legislature.

SELMA, ALA.—The Selma Water Co. is reported about to lay two miles of 4 and 6-in. mains.

TUSKALOOSA, LA.—The Tuskaloosa Water Co. has made a proposition to the council to sell the works to the city, the price to be agreed upon by a board of arbitration and payment to be made in 6% city bonds.

CLEVELAND, TENN.—The question of works is being considered, but no definite steps have yet been taken.

LOUISVILLE, KY.—A committee visited Atlanta last week investigating the question of a filter plant, Chas. Hormony, Supt.

ASHLAND, O.—Bids are asked until March 6 for constructing works, as stated in our advertising columns. Consult. Engr., J. B. Strawn, Salem, O.; Village Clk. O. G. Ducomb.

ASHTABULA, O.—The Astabula Water Supply Co. is reported as to build a crib into Lake Erie in the spring.

BARNESVILLE, O.—The question of a supply for fire protection is being agitated, owing to a recent $75,000 fire

CLEVELAND, O.—It is reported that the contract for 563 ft. of 48-in. steel pipe to be put in the 8-ft. tunnel has been awarded to W. B. Pollock & Co., of Youngstown, at $11,800; the lowest bid for 262 hydrants was that of the Crane Co., of Chicago, at $5,738; for 352 valves, the Rensselaer Mfg. Co., at $8,090, and the lowest for stop-cock boxes, etc., that of the Michigan Brass & Iron Works, at $6,778.

ELYRIA, O.—The council has passed a resolution requiring the water company to furnish filtered water and also requiring an increased pressure, the improvements to be made by July 1.

PORT CLINTON, O.—Bids are asked until Feb. 28 for constructing works as stated in our advertising columns. Engr., Chas. E. DeWitt; Village Clk., J. H. Faus.

MONTICELLO, IND.—It is reported that efforts are being made to secure works and that a franchise may be granted.

INDIANAPOLIS, IND.—The council continues to discuss plans for purchasing the works.

LADOGA, IND.—The Ladoga Water-Works Co. has been incorporated by S. L. Conn and others; capital stock, $12,000.

HARBOR SPRINGS, MICH.—An arbitration committee is deciding upon a price to be paid by the village for the works put in five years ago by E. Pray & Sons.

ARLINGTON, ILL.—It is stated that works will be put in this spring.

CHICAGO, ILL.—Bids are asked until Feb. 13 for 1,523 pieces of 24-in. cast iron water pipe. John McCarthy, Comr. Pub. Wks.

HARLEM, ILL.—The village board is reported as taking steps to secure plans and specifications for the extension of the water and sewer system on the south side.

KNOXVILLE, ILL.—Bids are asked until March 11 for the construction of works, as stated in our advertising columns. Consult. Engr., Chas. F. Sturtevant, St. Louis. L. M. Smith, Cy. Clk.

CENTERVILLE, IA.—J. P. Gribbin, Cy. Clk., writes us that two companies have petitioned for franchises, and that it is probable that a local company will put in the works, which will include about 7 miles of mains, a stand-pipe, and will cost about $55,000; supply from artesian well; population, 6,000.

WEST POINT, IA.—Joshua Hardy, Cy. Clk., writes us that the water-works proposition was voted down.

ANOKA, MINN.—Papers have been filed against the Anoka Water-Works & Electric Light Co. asking the court to annul the franchise.

PLAINVIEW, MINN.—A correspondent writes us that the contract for works will soon be let; estimated cost, $15,000.

CHEROKEE, KAN.—The bill introduced in the legislature, noted in our issue of Jan. 24, grants the city the right to purchase the present works instead of to put in new works, as stated in press reports.

INDEPENDENCE, KAN.—The city has petitioned for authority to establish works.

SABETHA, KAN.—Ed. Slosson, Cy. Clk., writes us that nothing has yet been done in regard to works or an electric light plant.

RICHMOND, MO.—At an election Jan. 28 a 20-year water-works franchise was granted to J. H. Christopher, of Warrensburg, by a vote of 676 to 21.

JONESBORO, ARK.—Jesse W. Starr is reported to have accepted the franchise and is to commence the construction of works about April 1; estimated cost, $50,000.

BELTON, TEX.—The Belton Water-Works Co. has been granted authority to increase its capital stock from $100,000 to $200,000.

COLEMAN, TEX.—J. S. Thatcher, of Dallas, has been engaged to prepare plans and specifications for works. A correspondent writes us that the works will consist of about four miles of 8 to 4-in. cast iron pipe, 20 hydrants, masonry reservoir, a 750,000-gallon pump and that the water supply will be obtained through a filter gallery built in bed of creek; construction to be commenced about March 1.

TEMPLE, TEX.—The Temple Water-Works Co. has voted to issue $250,000 in bonds to pay present indebtedness of $60,000 and to make extensions.

TERRELL, TEX.—The council has unanimously accepted the proposition of the directors of the water-works and will take possession of the plant April 1.

SACRAMENTO, CAL.—The trustees are reported as wanting to spend from $30,000 to $50,000 for two new pumps.

HIGHLANDS, COLO.—The Denver-Highlands Water Co., noted in our issue of Jan. 24 as petitioning for franchises, was incorporated Jan. 30; capital stock, $300,000; incorporators, Frank P. Arbuckle, R. H. Porter, A. C. Hoenig and others. The company will furnish water to the towns of Denver and Highlands but more especially to Barnum and Colfax.

BALLARD, WASH.—The city has sold $42,000 of bonds for water-works and an electric light plant.

ST. HELEN, ORE.—The question of a supply from springs on a hill is reported as being considered.

KNOWLTON, QUE.—At an election Jan. 30 the citizens voted, 57 to 44, in favor of an appropriation of $16,000 for works.

MONTREAL, QUE.—The Stadacona Water, Light & Power Co. has been incorporated by L. H. Tache, J. O. C. Mignault, E. C. Amos and others of this city to construct water-works and electric plants in the province of Quebec; capital stock, $40,000.

IRRIGATION.

HASTINGS, NEB.—Steps are being taken to form an irrigation district which will include three-fourths of Adams county.

BROWNWOOD, TEX.—Press reports state that the California Irrigation Co. has secured subscriptions of 20,000 acres in the vicinity of this city and will begin work when 40,000 are subscribed. The dam will be 13 miles north of here. The route is now being surveyed.

UVALDE, TEX.—A correspondent writes us as follows in regard to project noted last week: The Uvalde Irrigation Mfg. & Water Co. has just begun the construction of its works, the surveys and examinations for which were made by Robert Moore, St. Louis, last summer. Water will be taken from the Nuecis River above 20 miles above Uvalde and conveyed to the lands owned by the company, comprising about 25,000 acres. This enterprise contemplates the construction of a submerged sheet pile diverting weir driven to rock, the necessary flood and regulating gates, a wooden flume about 11½ miles long, with a capacity of 300 cu. ft. of water per second and from 10 to 15 miles of cement-lined ditches, of a capacity of from 250 to 100 cu. ft. per second. About 10,000 ft. of the flume will be supported on wooden trestles from 12 to 15 ft. in height. The estimated cost of the work is about $235,000. Pres. and Gen. Man., B. F. Buzard; Secy., W. Benson, Uvalde; Ch. Engr., Robt. Moore, St. Louis; Res. Engr., F. B. Maltby, Uvalde.

NEW COMPANIES.—American Falls Canal & Power Co., Ogden, Utah; $500,000; to build a canal near American Falls, Idaho; the canal will be 50 miles in length and 60 ft. in width; Pres., Lyman Skeen; Secy., J. J. Brummitt; Treas., S. H. Head; Gen. Man., Moroni Skeen; Ch. Engr., W. M. Bostaph.

Chino Ranch Co., Chino, Cal.; $3,000,000; to build water, gas, electric light and power works; C. H. Phillips, San Luis Obispo; A. E. Pomeroy, C. W. Gates, Los Angeles; Walter L. Vail, Pantano, Ariz.

SEWERAGE.

ELLSWORTH, ME.—The board of trade is agitating the question of a sewerage system.

BRADFORD, VT.—G. W. Chapman, Pres. Trustees, J. C. Stearns, and H. E. Parker have been appointed a committee to investigate the question of a sewerage system for this village.

BOSTON, MASS.—The metropolitan sewerage commissioners have reported as follows: The total length of the sewer upon the north metropolitan system and its branches (including pumping stations and siphons) is 215,756 ft. (about 41 miles). Of this the completed portion amounts to 191,817 ft. (36⅓ miles), while the portion remaining to be constructed amounts to 23,939 ft. (about 4⅔ miles). This is entirely independent of and separate from the Charles River Valley system, covering a distance of about 8¼ miles, which has been completed and in operation since the spring of 1892. The total cost to date is $4,888,873.

LYNN, MASS.—The council is reported as considering the extension of several important sewers this spring.

QUINCY, MASS.—The council has adopted a resolution requesting the mayor to petition for authority to issue $300,000 in bonds for a system to empty into the Moon Island sewage outlet.

PROVIDENCE, R. I.—Contracts for the sewer work recently advertised in Engineering News have been awarded as follows: For the foundation for the pumping station, disposal division, section 4, Fredk. E. Shaw, $38,176; section 15, siphon division, 967 ft., 78-in. sewer, Geo. R. Newman, $25,614; section 16, s.phon division, 800 ft., 48-in., in tunnel under Providence River, Chas. A. Haskin, $36,155; section 17, Moshassuck division, 2,185 ft., 62-in. sewer, Edward W. Everson, $54,397; section 18, Moshassuck division, 2,185 ft., 62-in. sewer, Geo. R. Newman, $57,444. Otis F. Clapp is the assistant city engineer in charge of sewers.

BRISTOL, CONN.—The citizens have voted to appropriate $50,000 for a trunk sewer.

BABYLON, N. Y.—The citizens have appointed a committee of five, including J. R. Reid and W. F. Norton, to consider plans for a system.

BUFFALO, N. Y.—The council has directed the board of public works to prepare plans and to advertise for bids for the construction of sewers in Skillen St. and Kensington Ave.——The board of public works has received the following bids for constructing a 42 and 27-in. brick and 12 and 10-in. pipe sewers in Kensington Ave. and 66 to 34-in. brick and 20 to 12-in. pipe sewers in South Ogden St.:

	Kensington Ave.	South Ogden St.
John Harrer	$8,000	.....
Christopher Smith	8,500	$11,420
Elmer Mighton	8,778	9,565
George W. Moore	8,787	11,005
John Mumm	8,998	12,260
Aug. Gisel	8,999	.....
W. A. Rappich	9,301	14,261
Jacob Ritzmann	9,768	11,833
Fred J. Martin	10,302	12,182
William Franklin	10,800	11,800
Thomas B. Reading	12,233	12,600
Henry Harter	11,421	11,556
W. G. Smith	....	10,761
A. R. Clark & Co.	....	13,573

CLINTON, N. Y.—At a special election Feb. 2 the citizens voted to construct sewers to cost $23,000. These sewers will be the nucleus of the system for which A. M. Scripture, of New Hartford, prepared plans three years ago.

ROCHESTER, N. Y.—The East Side trunk sewer commission has awarded the contract for a 5-ft. storm water outlet sewer to Lauer & Hagaman, at $22,994. The construction will not be commenced until the right of way in the bed of the canal has been obtained from the state. The itemized bids were published in our issue of Dec. 20. Oscar H. Peacock, Engr.

SYRACUSE, N. Y.—The plans of S. M. Gray for a complete system are expected to be completed next month.

ELIZABETH, N. J.—Bids are asked until Feb. 23 for constructing 900 ft. of 12-in. and 220 ft. of 15-in. pipe sewer, 10 manholes. N. K. Thompson, St. Comr.

HOBOKEN, N. J.—The contract for an outlet sewer through Ferry St. has been awarded to Thos. Cavanagh. Bids will soon be asked for constructing a brick sewer in two streets.

JERSEY CITY, N. J.—The council has voted to construct a 20-in. pipe and a 24-in. brick sewer.

MORRISTOWN, N. J.—The question of sewage disposal is being discussed. Fred. V. Pitney, Engr., is reported as stating that a filtration system can be put in for about $150,000.

PLAINFIELD, N. J.—Bids will soon be asked for the construction of 15¾ miles of sewers, as follows: 1,070 ft. of 24-in. vitrified pipe sewer; 2,320 ft. of 12-in.; 4,940 ft. of 10-in. and 74,830 ft. of 8-in. sewer. The depth of most of the work will not exceed 8 ft., the deepest cut being under 14 ft. The work will include 108 manholes, 160 lampholes, 5,700 ft. of underdrains and a number of flush tanks. It is expected that the construction of the outfall sewer and filtration beds will be advertised later in the spring. The itemized bids received for constructing the first section of this system were published in our issue of Sept. 13, 1894. James T. MacMurray is city clerk. A. J. Gavett, constructing engineer, and Geo. H. Frost, of this journal, is chairman of the committee.

ROSELLE, N. J.—C. P. Bassett, of Summit, has prepared plans for a sewer 14,550 ft. long, estimated to cost $22,400. The council is considering the question of construction.

ERIE, PA.—The city engineer has prepared plans for a sewer in State St. estimated to cost nearly $7,000.

HARRISBURG, PA.—The city engineer has been directed to prepare plans for sewers in East Harrisburg, to cost about $12,000.

CLEVELAND, O.—Bids are asked until Feb. 13 and 27 for constructing sewers. J. H. Farley, Dir. Pub. Wks.

INDIANAPOLIS, IND.—It is stated that probably 12 miles of sewers will be constructed this year, including 6 miles of intercepting sewers. Chas. C. Brown, Cy. Engr.

MARION, IND.—J. D. Cook, of Toledo, O., has been consulted in regard to a proposed sewerage system in this city.

EAST ST. LOUIS, ILL.—Bids are asked until Feb. 9 for constructing 1,700 ft. of 30-in., 3,350 ft. of 24-in., 1,400 ft. of 20-in. and a large amount of smaller sewers in two streets, the work requiring 13,200 cu. yds. of excavation and refilling. Alex. A. Abend, Cy. Engr.; M. M. Stephens, Mayor.

RIVERSIDE, ILL.—Sewers will soon be constructed in several streets, according to reports. L. F. Dyrenforth, Chn. Comrs.

OCONOMOWOC, WIS.—A topographical survey of the city has been completed with a view to putting in a system of sewers.

SHEBOYGAN, WIS.—Bids are asked until Feb. 15 for constructing sewers in several streets. John Schmidt, Cy. Comptroller.

KANSAS CITY, MO.—A bill has been introduced in the legislature forbidding the city from emptying its sewage into Turkey Creek. There are 26 acres of land drained by this creek and if this bill becomes a law the city engineer proposes the following two ways for overcoming the difficulties: One is by chemically treating the sewage, and the other is to build additional sewers to carry the sewage to the Missouri River, which will necessitate a considerable outlay on the part of the city.

ST. LOUIS, MO.—It is stated that a bill will be introduced in the legislature providing for the establishment of several drainage districts in St. Louis county. There are several thickly settled districts beyond the city limits in the county unprovided with sewers.

HOUSTON, TEX.—The "Post" states that the most important question which confronts the city is that of sewage disposal; the making of a sewer out of Buffalo Bayou is said to be utterly impracticable.

WACO, TEX.—A press report states that plans have been prepared for nearly 27,000 ft. of sewers; estimated cost, about $13,000.

GARBAGE DISPOSAL.

BOSTON, MASS.—A bill has been introduced in the legislature prohibiting the feeding to a food animal of any garbage collected by any city or town in the state. If this bill becomes a law several cities in the state that now feed garbage to swine will be obliged to seek other methods of disposal.

ROCHESTER, N. Y.—The Rochester Garbage Co. is reported to have purchased 40 acres of land in West Macedon, Wayne county, one mile east of the Monroe county line, as a site for its plant.

CAMDEN, N. J.—The contract for the erection of a garbage crematory has been awarded to the Dixon Crematory Co., of Findlay, O., at $9,995, according to reports. The bids were published in our issue of Jan. 17.

STREETS AND ROADS.

NEW BEDFORD, MASS.—The county commissioners are considering the question of the proposed boulevard between this city and Fall River.

PATCHOGUE, N. Y.—G. A. Roullier, Cy. Engr., Flushing, has prepared plans for the improvement of Main St., 33,500 sq. yds., at an estimated cost of $36,000; this street will probably be macadamized.

STAPLETON, N. Y.—Bids are asked until Feb. 25 for grading and constructing a macadam road on Staten Island, the work including 22,850 sq. yds. of macadam, 13,800 cu. yds. of excavation, etc. Henry P. Morrison, Engr.

ROCHESTER, N. Y.—Plans have been prepared for paving Garson Ave. with asphalt, at an estimated cost of $45,000.

UTICA, N. Y.—It is probable that several streets will be paved with asphalt. The "Press" urges that a department of public works be established and that additional paving be done by contract.

YONKERS, N. Y.—The committee has recommended that bids be asked for regulating and grading two streets.

MOUNT HOLLY, N. J.—Bids are asked until Feb. 13 for constructing a stone road. C. K. Vansciver.

TRENTON, N. J.—Bids are asked until Feb. 12 for macadamizing two roads. N. H. Furman, Dir. Bd. of Freeholders.

EASTON, PA.—Bids are asked until Feb. 28 for 5,700 sq. yds. of paving with vitrified brick on 6 ins. of concrete, as stated in our advertising columns. H. R. Fehr, Cy. Engr.

HARRISBURG, PA.—Bids are asked until Feb. 11 for grading three streets. John McConker, Highway Comr.

SCRANTON, PA.—The mayor has signed an ordinance for paving Franklin Ave. from Spruce to Mulberry Sts. with brick.—J. P. Phillips, Cy. Engr., has prepared plans for paving three streets, estimated to cost $3,428.

WASHINGTON, D. C.—Bids are asked by the district commissioners until Feb. 11 for paving certain alleys with asphalt, asphalt block or brick.

NEW ORLEANS, LA.—The city comptroller has been directed to advertise for bids for paving certain streets with gravel and stone blocks.

LOUISVILLE, KY.—The city engineer is preparing plans for reconstructing streets. It is stated that the work needed to be done would cost about $300,000, while only $106,000 is available.

CLEVELAND, O.—Press reports state that 16 miles of streets will be paved this year, at a cost of over $800,000.

MARION, O.—Bids will be asked for paving two streets as soon as the plans and specifications are completed. T. C. Bowen is city engineer.

FORT WAYNE, IND.—Bids are asked until Feb. 28 for a supply of cedar blocks. A. J. You, Clk. Dep. Pub. Wks.

WASHINGTON, IND.—The council has voted in favor of paving several streets with brick.

EAST ST. LOUIS, ILL.—Bids are asked until Feb. 9 for improving two streets, the work including 43,900 sq. yds. of brick paving, 39,200 cu. yds. of filling, and 14,500 cu. yds. of excavation. Alex. E. Abend, Cy. Engr. M. M. Stephens, Mayor.

OTTUMWA, IA.—Bids are asked until Feb. 18 for paving two streets with brick, with 5-in. stone curbing. A. M. Buchannan, Chn. Com.

HOUSTON, TEX.—The Houston Construction Co. has been awarded contracts for paving several streets with two courses of brick on 6 ins. of gravel.

CRIPPLE CREEK, COLO.—The Cripple Creek, Gillett & Pikes Peak Toll Road Co. was incorporated Jan. 29 to build a toll road from Cripple Creek and Gillett to the top of Pikes Peak; capital stock, $500,000; incorporators, Chas. Kinney, C. M. Cranston and F. M. Jeffery.

RIVERSIDE, CAL.—The city trustees are taking steps to pave several streets, and it is reported will buy a rock crusher.

MONTREAL, QUE.—The city surveyor has recommended that $10,475 be appropriated towards paving Brock St. tunnel this winter.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

FILLING RAVINE.—San Francisco, Cal.—Bids are asked until Feb. 25 for filling ravine at the Presidio. A. S. Kimball, Ch. Q. M.

DREDGING.—Washington, D. C.—The senate has passed a bill appropriating $15,000 for dredging channel of Indian River Inlet, Fla.

GRADE CROSSING.—Newton, Mass.—The city council has passed an order instructing the mayor to petition the General Court for authority to remove certain grade crossings.

STEEL FLAGPOLE.—Buffalo, N. Y.—The board of public works has been instructed to prepare plans and advertise for bids for a steel liberty pole on the terrace, to be 175 ft. high.

BOILER.—Boston, Mass.—Bids are asked until Feb. 12 for a new steam boiler and a new lined chimney for the U. S. lighthouse tender "Myrtle." Maj. W. R. Livermore, U. S. Engr. Office.

STEAM PUMPS.—St. Louis, Mo.—Bids are asked until Feb. 20 for two steam pumps for tow and dredge boat, as stated in our advertising columns. Maj. Chas. J. Allen, U. S. Engr. Office.

BREAKWATER.—East Marion, N. Y.—Efforts are being made to have the state build a stone breakwater in Peconic Bay, estimated to cost $20,000. B. D. Skinner, of Southold, is interested.

REMOVING SHOAL.—Detroit, Mich.—Bids are asked until March 1 for removing portions of a shoal at the upper end of Hay Lake Channel; also for cleaning up shoals. Col. O. M. Poe, U. S. Engr. Office.

STONE, CEMENT, ETC.—Duluth, Minn.—Bids are asked until Feb. 28 for furnishing cement, broken stone, sand, iron and timber for concrete superstructure for breakwater at Marquette, Mich. Maj. Clinton B. Sears, U. S. Engr. Office.

REMOVING DREDGE.—New York, N. Y.—Bids are asked until Feb. 27 for the purchase, including the removal, or for the removal alone of the sunken dredge "Flood Rock," lying in the east channel of the East River. Lieut.-Col. G. L. Gillespie, U. S. Engr. Office.

PIER REPAIRS.—Cleveland, O.—Bids are asked until Feb. 12 for furnishing and delivering timber and iron for repair of pier at entrance to Monroe Harbor, Mich.; also for extension of piers, improving harbors at Huron and at mouth of Black River, O. Lieut.-Col. J. A. Smith, U. S. Engr. Office.

ICE MACHINERY AND BOILER HOUSE.—Milwaukee, Wis.—The Blatz Brewing Co. is reported about to begin the erection of a boiler house 75 x 102 ft., with a chimney 235 ft. high, which will contain, in addition to boilers, an ice machine of 450 tons capacity; estimated cost of work, $200,000.

ELECTRICAL SUBWAYS.—Baltimore, Md.—Bids are asked until March 1 for the complete electrical equipment of the electrical subways of the police and fire department telegraph system, the equipment to include 130,000 ft. of bunched cables, from 2 to 80 conductors, etc. N. S. Hill, Jr., Engr., 508 Equitable Bldg.

CANAL.—Milwaukee, Wis.—The "Sentinel" states that a company with $20,000 capital stock has been formed for the purpose of building a canal to connect Oconomowoc, the Nashotah and upper Nemahbin lakes, and work, it is said, will begin early in the spring. The incorporators are M. M. Hill, L. F. Hodges, E. J. Lindsay, George P. Gifford and Warham Parks. Between Oconomowoc and upper Nashotah lakes two locks will be built, with a rise of 8 ft.

RIVER IMPROVEMENTS.—Washington, D. C.—The following river improvements have been favorably reported after preliminary survey by the engineer corps: Dredging and clearing of obstructions, Okanogan River, Wash.; removing snags, Kootenai River, Idaho; constructing reservoirs, Big Stone Lake; widening and deepening channel, Machias River, Me. The following were adversely reported: Improving Umpqua River, Ore.; Shiawassee, Bad and Flint rivers, also South Creek, N. C.

CONTRACT PRICES.

CAST IRON PIPE.—Evansville, Ind.—A contract for a supply of 6-in. cast iron pipe has been awarded to the Anniston Foundry & Pipe Co., the bids per ton of 2,000 lbs. being as follows:

	6-in.	16-in.	Specials.
South Pittsburg Pipe Works..	$18.90	$18.90	$50.00
Howard-Harrison Iron Co.....	18.25	18.25	50.00
Anniston Pipe & Foundry Co..	18.00	17.50	40.00
Chattanooga F'dry & Pipe Co.	19.40	18.40	45.00

Grand Rapids, Mich.—A contract for about $2,000 worth of pipe has been awarded to the Addyston Pipe & Steel Co., at $19.65 per ton for pipe, and 2¼ and 2¾ cts. per lb. for old pattern and new pattern special castings, respectively.

Manchester, H. H.—The contract for $13,000 worth of cast iron pipe has been awarded to R. D. Wood & Co., at $20.25 per gross ton. These figures are reported as the lowest ever made by the city.

VALVES AND HYDRANTS.—The board of public improvements received the following bids, according to local papers, for 54 valves, 8, 6 and 4-in., and 40 fire hydrants; the department to have the right to increase or decrease this quantity 50%: Bert. Fox & Co., of Pittsburg, $6, $9 and $15 on valves; Columbus Rubber & Belting Co., the same; Ludlow Valve Co., $6.50, $10.75 and $16.15 on valves and $31.65 on hydrants, with $3 extra for patent frost jacket; R. D. Wood & Co., valves, $6.95, $10.70 and $15.50, and hydrants, $26.50 and $28 on the patent double; R. D. Potts, valves, $6.50, $10.95 and $16, and hydrants $29; Michigan Brass & Iron Wks., valves, $6.20, $10.30 and $15, and hydrants, $29.75; Bourbon Copper & Brass Wks., valves, $6, $10.25 and $15.60, and hydrants $30.31. Holly Mfg. Co., valves, $6.95, $11.50 and $17.40, hydrants, $26.70.

SEWERS.—Jersey City, N. J.—The following bids were received for a brick sewer in three streets:

Bids for Constructing a Brick Sewer at Jersey City, N. J.

	P. T. Plunkett.	P. H. Flaherty, Jr., & Co.	Sheridan, Shea & Co.	P. F. Brennan.	Graham Van Keuren.	L. McGovern.	Edw. O'Neil.	Jos. H. Jones.	M. T. Connolly.	Thos. Wood.
Brick oval sewer—24-in.	$2.60	$2.60	$2.48	$2.45	$2.35	$2.39	$2.00	$3.75	$3.20	$2.60
" " " —30-in.	2.80	2.85	2.92	3.10	3.00	2.59	2.25	4.25	3.45	3.00
" " " —36-in.	3.00	3.00	3.35	3.25	4.00	2.79	3.00	5.10	3.70	3.00
Sheathing, 15 M. ft.	.01	25.00	20.00	10.00	.01	9.00	20.00	25.00	17.00	15.00
Rock excavating	.01	1.00	.50	.05	.01	.09	.01	2.00	2.25	.01
Receiving basins	70.00	100.00	85.00	75.00	80.00	89.00	75.00	100.00	85.00	100.00
Concrete	.01	1.00	.10	.05	.01	.09	1.00	.01	5.00	.01

DRAINAGE CANAL.—Chicago, Ill.—F. C. Weir, of Cincinnati, to whom the contract for completing section F of the drainage canal was awarded, has qualified for the work on condition that he be allowed to take into partnership the next lowest bidder. Mr. Weir bid 29½ and 90 cts. per cu. yd., respectively, for glacial drift and rock excavation, and afterwards requested permission to withdraw his bid, claiming a mistake, which was refused. The bids were published in our issue of Jan. 17.

SEWER BRICK AND GRAVEL.—Louisville, Ky.—The lowest bid for furnishing brick for sewer repairs was that of Robt. L. Clark, at $7.50 per M., and the lowest for bond gravel that of James T. Duffy, at 68 cts. per cu. yd. The bids for broken stone ranged from 85 cts. to $1.34 per cu. yd.

Allegheny, Pa.—The contract for a main sewer in Morgan and other streets has been awarded to Jas. H. McQuaid at the following prices:

24-in. cast iron pipe, 120 ft., at	$2.75
24-in. D. S. pipe, 1,400 ft., at	1.69
20-in. D. S. pipe, 200 ft., at	1.36
Inlets, 11, each	20.00
Manhole shafts, 12, each	22.00

DREDGING.—Galveston, Tex.—A press report from this city states that the contract for excavating 1,000,000 cu. yds. of earth for a harbor and channel in front of Texas City, entered into a few days ago by the Texas City Improvement Co. and President Lauden, of the American Hydraulic Dredging Co., of Chicago, was filed with the county clerk of Galveston county Jan. 26. The contract specifies that the company shall excavate 1,000,000 cu. yds. at 26 cts. per cu. yd., 22 cts. of which is to be paid in lots at Texas City at the present list price. Of the other 4 cts. per cu. yd., the dredging company is to take 25% of the cash sales of the Texas City Improvement Co. for one year from the commencement of the work. If at the end of the year the additional 4 cts. is not paid, then the Chicago company will take what is due them out in additional real estate. The face of the contract is $260,000. The contract specifies that the work shall begin immediately and shall proceed night and day and be completed in ten months.

ASPHALT PAVING.—Syracuse, N. Y.—The contract for paving Mulberry St., from Onondaga to Colvin St., was awarded Jan. 28 to A. F. West, of Buffalo, the bids being as follows:

	Sq. yd.	Total.
Syracuse Improvement Co.	$2.40	$102,492
Andrew F. West, Buffalo	1.96	68,158
G. D. Grannis	1.97	85,392
William H. Swift, St. Louis	1.87	79,852
Trinidad Asphalt Refining Co.	2.39	81,876
Bermudez Asphalt Paving Co.	1.68	72,672
Rock Asphalt Paving Co.	2.60	103,102
Warren-Scharf Asphalt Paving Co..	2.65	111,492

The contract for paving Fitch St. was awarded to the Bermudez Asphalt Paving Co., and that for Bellevue Ave. to the Trinidad Asphalt Refining Co. Bids for these two streets were opened a week earlier than those for Mulberry St.

BREAKWATER.—Cincinnati, O.—The following bids were received by Lieut.-Col. Amos Stickney for 2,550 cu. yds. of stone in place for protecting embankment at Shawneetown, Ill.:

Eli Cox, Holton, Ind., per cu. yd.	$2.50
W. A. Kirk, Madison, Ind.	1.65
DuPont Improvement Co., Shawneetown	1.65
Hampton G. Grainger, Caseyville, Ky.	1.90
Halloran & Katterjohn, Jr., Paducah, Ky.	1.88

METAL MARKET PRICES.

LEAD.—New York: 3.12 to 3.15 cts. Chicago: 3 to 3.05 cts. St. Louis: 2.92 to 3 cts.

NAILS.—Pittsburg: 85 cts. for wire, and 80 cts. for cut at mill in carload lots.

BARBED WIRE.—Pittsburg: Galvanized, $1.85 to $1.90; plain, $1.20 to $1.25 for carloads at mill.

FOUNDRY AND PIG IRON.—New York: $10.00 to $12.00. Pittsburg: $9.75 to $10.65. Chicago: $9.50 to $10.50.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.45 to 1.6 cts.; track bolts, 1.8 to 1.9 cts. with square, and 1.9 to 2 cts. with hexagon nuts. Chicago: angle bars, 1.3 to 1.35 cts.; spikes, 1.6 to 1.7 cts.; track bolts, 1.9 to 2 cts., with hexagon nuts.

RAILS.—New York: $22 at eastern mills and $22.75 at tidewater; old rails, $11.50 to $12 for iron, and $10 to $10.50 for steel; steel rails fit for relaying, $14.00; light rails, $21; girder rails, $24. Pittsburg: $22 for standard sections of 45 lbs. and over: $23 for light sections; old rails, $12 for iron and $9 to $11 for steel. Chicago: $23 for standard sections; $25 for light sections; old rails, $10 to $11 for iron, and $6.50 to $9 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.25 to 1.4 cts. for tank, 1.4 to 1.45 cts. for shell, 1.5 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.2 to 1.25 cts.; channels, 1.2 to 1.25 cts.; angles, 1.05 to 1.15 cts.; tees, 1.3 to 1.35 cts.; universal mill plates, 1.05 to 1.15 cts.; steel plates, 1.15 to 1.25 cts. for tank, 1.3 to 1.35 cts. for shell, 1.35 to 1.4 cts. for flange, 2.5 to 3.75 for ordinary firebox, and 3.35 to 3.5 cts. for locomotive firebox. Chicago: beams, 1.45 to 1.5 cts.; channels, 1.45 to 1.5 cts.; angles, 1.3 to 1.35 cts.; tees, 1.55 to 1.6 cts.; universal plates, 1.4 to 1.45 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.5 to 2 cts. for flange, 2 to 4.5 cts. for firebox.

INDUSTRIAL NOTES.

THE OLIVER SHEET IRON MILL, at Easton, Pa., will soon be put in operation.

THE HERCULES PIPE WORKS, of Anniston, Ala., have been leased by E. L. Tyler.

THE BUCKEYE MFG. CO., of Anderson, Ind., has shipped six 20-HP. gasoline engines.

THE ALEXANDER CAR REPLACER CO., of Scranton, Pa., is manufacturing a pressed steel car replacer.

THE AMERICAN LUBRICATING CO., of Cartaret, N. J., has its plant destroyed by fire Jan. 28, involving a loss of $20,000.

THE ROYAL BRICK CO., of Canton, O., had its paving brick plant destroyed by fire Jan. 29, involving a loss of $35,000.

THE OHIO FALLS CAR MFG. CO., of Jeffersonville, Ind., has a contract for 350 ventilated box cars for the Southern Ry.

THE DOVER BOILER WORKS, of Dover, N. J., have a contract for two cupolas 9 × 30 ft. for limekilns at McAfee, N. J.

THE BRICKMAKING PLANT of Elcock & Sultzaberger, at Springfield, Ill., was burned Jan. 25, involving a loss of $10,000.

THE E. P. ALLIS CO., of Milwaukee, Wis., has shipped a 300-HP. engine and mine hoisting plant to Jouannesburg, So. Africa.

THE AMERICAN ALUMINUM CO., of St. Louis, Mo., is building works at Keesville, Mo., for the manufacture of bars and ingots.

THE FULTON TRUCK & FOUNDRY CO., of Mansfield, O., has a number of orders on hand for its Fulton truck for electric cars.

THE AUERBACH WOOLVERTON ELECTRIC CO., of New York city, is putting on the market an enclosed arc lamp with an improved feed.

THE HAZARD MFG. CO., of Wilkes Barre, Pa., has delivered a 62-ton traction cable to the Metropolitan Street Ry. Co., of New York.

THE DELAWARE IRON WORKS, of New Castle, Del., have orders for steel trolley poles for electric cars in Bristol, England, and Dublin, Ireland.

REFRIGERATOR CAR WORKS are reported as to be established at Annandale, Kan., by a company having $3,500,000 capital and backed by eastern capitalists.

THE READING IRON CO., of Reading, Pa., will extend its plant in North Reading, and put up a rolling mill 200 × 200 ft., and a puddle mill 100 × 230 ft.

DIETZ, SCHUMACHER & CO., of Cincinnati, O., have shipped a number of lathes and drill presses to the University of the State of Missouri at Columbia, Mo.

THE OHIO STEEL CO., of Youngstown, O., expects soon to start its works, making billets, sheets and bars, and later undertaking rails and structural work.

THE WHITING FOUNDRY EQUIPMENT CO., of Chicago, Ill., has delivered a cupola of 10 tons capacity to the Rogers Locomotive & Machine Works, of Paterson, N. J.

THE LEWIS & FOWLER MFG. CO., of Brooklyn, N. Y., is in the hands of a temporary receiver, but the manufacture of street car appliances and fittings will be continued.

THE FALLS RIVET & MACHINE CO., of Cuyahoga Falls, O., has acquired the business of the Chicago Snafting & Pulley Co., and will manufacture shafting, friction clutches, pulleys, etc.

THE ST. LOUIS CAR CO., of St. Louis, Mo., is building 75 side-door 30-ft. electric cars for the Detroit Ry. Co., Detroit, Mich. The cars have 10 cross-seats shorter than the width of the car.

THE TANITE CO., of Stroudsburg, Pa., manufacturing emery wheels, etc., states that A. G. Sinclair, formerly President of the New York Emery Co., has become connected with the Tanite Co.

THE CRESCENT COTTON-SEED OIL MILL, at Little Rock, Ark., was burned Jan. 26, involving a loss of $75,000 on the building and machinery. It was owned by Austin Bond, of Memphis, Tenn.

THE JEFFRY MFG. Co., of Columbus, O., has put in a coal-conveying plant for the Cambria Iron Co. at Johnstown, Pa. It can handle 70 tons of coal per hour, and runs at a speed of 80 ft. per minute.

THE PARK IRON & STEEL CO., of Muncie, Ind., has been organized by T. F. Rose and others, with a capital stock of $50,000, to operate the plant of the capital stock of $50,000, to operate the plant of the White River Iron & Steel Works recently sold by auction.

THE JOHNSON RAILROAD SIGNAL CO., of Rahway, N. J., has had an application made for the appointment of a receiver. The company was organized in 1880 and has done a large business in signal and interlocking plants.

THE CARTER BRAKE CO., 1331 Monadnock Block, Chicago, is introducing a street car brake in which the brakeshoes are between the wheels and below the axles, and are raised by a lever to bring them in contact with the wheel treads.

THE NEW YORK FILTER CO., of Elizabeth, N. J., has had John R. Hardin, of Newark, N. J., appointed as receiver. The company's embarrassment is said to be due to its failure to collect its claim of $134,500 against the city of New Orleans.

THE CATSKILL SHALE BRICK CO., of Catskill, N. Y., is putting up a large plant for the manufacture of vitrified shale paving and building brick. It will have a capacity of 100,000 to 150,000 brick per day. Mr. J. F. Harris, Jr., is secretary of the company.

THE STANDARD STEEL WORKS, of Burnham, Pa., have built a new machine shop and a power house for electric light and pumping plant, and an open-hearth furnace is to be built. Electric power will operate the charging machine for this furnace, as well as the 25-ton crane in the steel casting shop.

THE YALE & TOWNE MFG. CO., of Stamford, Conn., having sold out to the Brown Hoisting & Conveying Co., of Cleveland, O., the business of its crane department, as already noted in our columns, is now having a clearing sale of cranes, winches and crabs at reduced prices.

THE SCHENECTADY LOCOMOTIVE WORKS, of Schenectady, N. Y., have built two 12-wheel or mastodon engines for the mountain division of the Central Pacific Ry. They weigh 173,000 lbs., and the tenders weigh 93,800 lbs. when loaded with 4,000 gallons of water and 12 tons of coal.

THE NATIONAL SWITCH & SIGNAL CO., of Easton, Pa., has recently received an order for interlocking the crossing of the Indiana, Illinois & Iowa R. R. with the Wabash R. R. at North Liberty, Ind. The machine will consist of 24 working levers, operating 10 switches, 5 facing point locks and 15 signals.

THE RHODE ISLAND LOCOMOTIVE WORKS, of Providence, R. I., have built one 10-wheel Johnstone four-cylinder compound engine, and one simple 10-wheel engine, for the Mexican Central Ry., and are at work on 25 consolidation freight engines for the New York, New Haven & Hartford R. R., and an eight-wheel engine for the Unadilla Valley R. R.

THE CLARK STOVE CO., of Annandale, Kan., will erect new brick buildings at a cost of $200,000 as follows: Foundry, 55 × 128 ft.; two-story erecting shop, 55 × 60 ft.; two-story office and warehouse, 55 × 60 ft. The company has a capital stock of $100,000, and the incorporators are R. M. Clark, O. A. Clark and H. N. B. Umbach.

A DREDGE AND STEAM SHOVEL PLANT is reported as projected at Bucyrus, O., to succeed the Bucyrus Steam Shovel & Dredge Co., which moved some years ago to South Milwaukee, Wis., and whose old works are still unoccupied. The company is to have $100,000 capital stock.

THE LEONARD SMOKELESS POWDER CO., of Nashville, Tenn., with New York offices at 15 Broad St., has made an assignment. The company has works for the manufacture of gunpowder and high explosives at Bayonne, N. J., but much expensive experimental work has been done. Pres., C. F. Meek; Secy., G. V. Whistler.

THE NATIONAL ASSOCIATION OF MANUFACTURERS has been organized at Cincinnati, O., and the following officers have been elected: Pres., Thomas Dolan, Cramp Ship & Engine Building Co., Philadelphia, Pa.; Secy., S. P. Wilson, Cincinnati, O.; Treas., Robert Laidlaw, Cincinnati, O. The general offices will be in Cincinnati.

THE FOSTER ENGINEERING CO., of Newark, N. J., has an order for two valves, 18-in. and 14-in. diameter, for the Anheuser-Busch Brewing Association, of St. Louis. These pressure regulators are of the Foster new "Class W" style, and will be the largest reducing valves ever turned out of these works, while it is said that few, if any, pressure regulators of equal size are now in service.

THE BROOKLYN STORAGE & WAREHOUSE CO., of Brooklyn, N. Y., recently incorporated with a capital of $12,000,000, will acquire the docks, elevators, sheds, stores, etc., on 2¾ miles of waterfront from Gowanus Bay to above the Brooklyn Bridge, the length of bulkhead being 5 miles. Improvements will be made, new elevators built and tracks laid, by which cars can be run from floats to any part of the property. Alexander E. Orr, David Dows and Franklin Woodruff are among the directors.

THE GENEVA WASHED GRAVEL CO., which was recently incorporated, has purchased the plant of the Illinois Washed Gravel Co., at Geneva, Ill. The plant consisting of two sets of rotary screens and a complete Hoyt gravel-washing and grading plant. The pits now have a daily capacity of 30 carloads The new company will make a specialty of furnishing gravel for paving, roofing and building purposes. The main office is in the Ogden Building, Chicago. Pres., Thomas Snow; Secy. and Treas., Benjamin W. Dodson.

THE BUCYRUS STEAM SHOVEL & DREDGE CO., of South Milwaukee, Wis., writes us that it wishes to emphasize the statement that the receivers propose to continue the business of the company and hope to work it out so that the creditors will receive full value for their claims. The receivership was made necessary by losses incident to certain new specialties in the manufacture of machinery for placer mining which the company has been putting out during the past two years. The receivers are John S. George and Howard P. Eels, the latter being Vice-Pres. and Treas. of the company.

THE FLORIDA DREDGING CO., of Tampa, Fla., has the contract for a fumigating station at Tiger Island and shoals, opposite Fernandina. There will be a wharf 125 × 54 ft. of palmetto and pine piling, painted with carbolineum as a preservative; and a building 30 × 90 ft. fitted with the fumigating plant. The building is for the State Board of Health, and will cost about $12,000. The company has also a government contract to deepen the channel in Charlotte Harbor, for which an appropriation of $20,000 was made. The company will remove about 70,000 cu. yds., and will receive about $16,500, the other $3,500 being for surveys, office work, etc. The company is fitting up a dredge of 1,000 cu. yds. daily capacity, and two large dump scows, which will be sent to Punta Gorda as soon as possible. It will begin the work by March 1, and complete it in about four months.

NEW COMPANIES.—Universal Engineering Co., Baltimore, Md.; machinery and electrical work; $10,000; Geo. W. F. Vernon, T. F. Wilcox and Julius Stern.

Bradley Filter Co., Syracuse, N. Y.; $50,000; C. C. Bradley and Calvin S. Bunnell.

Michigan Bridge Co., Portland, Mich.; $10,000; Samuel S. Ramsey, Alonzo Bells and C. L. Ramsey.

Harrison Electric Co., Chicago, Ill.; $50,000; Edward M. Harrison, Lewis H. Painter and Louis Rinaker.

Vitrified Brick Co., Chicago, Ill.; $50,000; Edmund S. Cummings, Daniel V. Harkins and Harry G. Colson.

Newburg Dredging Co., Newburg, N. Y.; $50,000; Thomas S. Marvel, George Field and David C. Miller.

Lakeside Sand & Gravel Co., Chicago, Ill.; $5,000; W. R. Blakemore, Geo. J. Schmidt and John J. Booz.

Geyser Compress & Warehouse Co., Waco, Tex.; $100,000; J. S. McLendon, G. W. Neville and M. G. Houghton.

Economical Gas Governor Mfg. Co., Chicago, Ill.; $250,000; A. O. Cooper, F. C. Farnum and Edward L. Bradbury.

Welliver Hardware Co., Danville, Pa.; pipe and hardware; $25,000, commencing with $2,500; Treas., H. H. Furman.

Locomotive Valve Gear Mfg. Co., East St. Louis, Ill.; $500,000; H. N. Metcalf, Eugene Parrish and G. B. Carstarphen.

Suburban Telegraph Co., Westchester, N. Y.; $10,000; Wm. Bryant, Geo. E. Shepard and Thomas P. Tighe, New York city.

Cook-Stoddard Mfg. Co., Dayton, O.; $30,000; gas, steam and electric engines; Hugo Cook, Henry Stoddard and W. W. Kinnard.

Santa Barbara Ice Co., Santa Barbara, Cal.; $50,000, with $20,000 subscribed; G. E. Voorhees, G. S. Edwards and L. H. Dreyfus.

King Mfg. Co., West Troy, N. Y.; $15,000; the King waste water trap and plumbing specialties; $15,000; Fayette B. Durant and John H. King.

United Switch Co., Newark, N. J.; electrical machinery; $100,000, commencing with $1,000; Henry C. Hines, W. C. Morton and Robert D. Beatty.

Tellkampf Mfg. Co., New York, N. Y.; $1,000,000, commencing with $300,000; car wheels and car trucks; Charles Thompson, Ernest Potter and A. F. Wilcox, all of Oswego Falls, N.Y.

High Point Iron Association, Port Jervis, N. Y.; $100,000, commencing with $25,000; gas and waterworks, etc.; Chas. St. John, of Port Jervis, N. Y., and N. Burrows, Wantage, N. J.

Cushing-Wetmore Co., San Francisco, Cal.; $100,000, all subscribed; concrete and artificial stone, builders' material, etc.; Geo. P. Wetmore and Daniel O'Callaghan, of San Francisco, and S. S. Cushing, of San Rafael.

THE COST OF STEEL BILLETS.

It is a somewhat difficult matter to present any figures of general value in relation to the cost of making steel billets, because the conditions vary with nearly every plant. The heavy decline in prices during the last two years has led many familiar with the work, although not having access to details, to the assumption that many producers must be working at a loss. Sellers as well as buyers in other sections have shrugged their shoulders over the doings of the works in the Pittsburg, Wheeling or Valley districts. Many have insisted that it must be only a matter of time when they must exhaust their resources. We believe it should be thoroughly understood that with the present prices of raw materials the well equipped plants in the central West are still holding their own, while some may contrive to gather in a modest profit.

On the basis of $10 Bessemer pig we make the following estimate of cost of conversion, calling the waste 15%:

Estimated Cost of Conversion of Pig into Billets.

Waste, 15%	$1.50
Ferromanganese	.40
Coke	.30
Coal	.30
Limestone	.10
Refractories	.20
Molds and stools	.25
Various supplies	.10
Repairs and betterments	.35
Laboratory and office	.15
All labor	1.10
Total	$4.75

This does not, of course, include interest on plant, taxes, water supply, and a number of smaller items. It does not, however, embrace, on the other hand, any credit item for value of pit scrap and crop ends. It justifies the statement that an estimate of $5 for cost of conversion on $10 pig iron is not ruinous to a modern steel plant in the central West, and that therefore the producers in other districts must face the fact that exhaustion does not necessarily follow a brief period of $15 for common billets at Pittsburgh, or its equivalent in other localities.

There is not, of course, any inducement to rush into the business at these figures, although the very latest plants can probably do somewhat better. It is equally true that makers are entitled to a living profit, so that they can stand the depreciation in value of plant due to progress in practice, and receive fair compensation for risks of all kinds which they must incur.—"The Iron Age."